R&S®FSV3-K10x (LTE Uplink)
LTE Uplink Measurement Application
User Manual

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Version 09

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®FSV3000 and R&S®FSVA3000 models with firmware version 2.20 and higher:

- R&S®FSV3004 (1330.5000K04) / R&S®FSVA3004 (1330.5000K05)
- R&S®FSV3007 (1330.5000K07) / R&S®FSVA3007 (1330.5000K08)
- R&S®FSV3013 (1330.5000K13) / R&S®FSVA3013 (1330.5000K14)
- R&S®FSV3030 (1330.5000K30) / R&S®FSVA3030 (1330.5000K31)
- R&S®FSV3044 (1330.5000K43) / R&S®FSVA3044 (1330.5000K44)
- R&S®FSV3050 (1330.5000K50) / R&S®FSVA3050 (1330.5000K51)

The following firmware options are described:

- R&S®FSV3-K101 (EUTRA/LTE FDD uplink measurement application) (order no. 1330.5151.02)
- R&S®FSV3-K103 (EUTRA/LTE advanced UL measurements) (order no. 1330.7231.02)
- R&S®FSV3-K105 (EUTRA/LTE TDD uplink measurement application) (order no. 1330.5180.02)

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1178.9226.02 | Version 09 | R&S®FSV3-K10x (LTE Uplink)

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®FSW is indicated as R&S FSW.

Contents

1 Documentation overview

This section provides an overview of the R&S FSV/A user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/FSVA3000

www.rohde-schwarz.com/manual/FSV3000

Further documents are available at:

www.rohde-schwarz.com/product/FSVA3000

www.rohde-schwarz.com/product/FSV3000

1.1 Getting started manual

Introduces the R&S FSV/A and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

1.2 User manuals and help

Separate user manuals are provided for the base unit and the firmware applications:

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Firmware application manual
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSV/A is not included.

The contents of the user manuals are available as help in the R&S FSV/A. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

All user manuals are also available for download or for immediate display on the Internet.

1.3 Service manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for registered users on the global Rohde & Schwarz information system (GLORIS):

R&S®FSVA3000/FSV3000 Service manual

1.4 Instrument security procedures

Deals with security issues when working with the R&S FSV/A in secure areas. It is available for download on the internet.

1.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

1.6 Specifications and brochures

The specifications document, also known as the data sheet, contains the technical specifications of the R&S FSV/A. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/FSV3000 /

www.rohde-schwarz.com/brochure-datasheet/FSVA3000

1.7 Release notes and open-source acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current software version, and describe the software installation.

The software uses several valuable open source software packages. An open source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/FSV3000 /

www.rohde-schwarz.com/firmware/FSVA3000

1.8 Application notes, application cards, white papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/FSV3000 /

www.rohde-schwarz.com/application/FSVA3000

1.9 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

2 Welcome to the LTE measurement application

The R&S FSV/A-K101, -K103 and -K105 are firmware applications that add functionality to perform measurements on LTE signals according to the 3GPP standard to the R&S FSV/A.

This user manual contains a description of the functionality that the application provides, including remote control operation. Functions that are not discussed in this manual are the same as in the Spectrum application and are described in the R&S FSV/A User Manual. The latest versions of the manuals are available for download at the product homepage.

https://www.rohde-schwarz.com/manual/fsv3000.

2.1 Overview of the LTE applications

You can equip the R&S FSV/A with one or more LTE applications. Each of the applications provides functionality for specific measurement tasks.

R&S FSV/A-K100

The R&S FSV/A-K100 is designed to measure LTE FDD signals on the downlink.

The application has the following features:
- Basic signal characteristics (like frequency, channel bandwidth or cyclic prefix).
- Demodulation and configuration of the PDSCH transmitted over a single antenna and without precoding functionality.
- Characteristics of the Synchronization and Reference signals.
- Consideration of various control channels in the measurement (for example the PBCH or the PPDCH).
- Analysis of individual antennas in a MIMO setup.
- Tools to refine and filter the measurement results.
- Various result displays that show the measured signal characteristics in a diagram or a numeric result table.
- Available measurements: EVM, ACLR and SEM.

R&S FSV/A-K101

The R&S FSV/A-K101 is designed to measure LTE FDD signals on the uplink.

The application has the following features:

- Basic signal characteristics (like frequency, channel bandwidth or cyclic prefix).
- Demodulation and configuration of the subframes transmitted over a single antenna.
- Characteristics of the demodulation and sounding reference signals.
- Consideration of the PUSCH, PUCCH and PRACH channels.
- Analysis of individual antennas in a MIMO setup.
- Tools to refine and filter the measurement results.
- Various result displays that show the measured signal characteristics in a diagram or a numeric result table.
- Available measurements: EVM, ACLR and SEM.

R&S FSV/A-K102

The R&S FSV/A-K102 is designed to measure LTE Advanced systems and MIMO systems on the downlink.

Note that this application only works in combination with either R&S FSV/A-K100 or -K104.

The application has the following features:

- Support of 1024QAM modulation.
- Consideration of the precoding schemes defined in the 3GPP standard.
- Support of carrier aggregation.
- Measurements on multimedia broadcast single frequency networks (MBSFNs).
- Additional measurements: time alignment error, multi-carrier ACLR, cumulative ACLR and multi-SEM.

R&S FSV/A-K103

The R&S FSV/A-K103 is designed to measure LTE Advanced systems on the uplink.

Note that this application only works in combination with either R&S FSV/A-K101 or -K105.

The application has the following features:

- Support of 256QAM modulation.
- Consideration of the enhanced PUSCH and PUCCH characteristics.
- Support of carrier aggregation.
- Additional measurements: time alignment error, multi-carrier ACLR and multi SEM.

R&S FSV/A-K104

The R&S FSV/A-K104 is designed to measure LTE TDD signals on the downlink.

The features are basically the same as in the R&S FSV/A-K100 with additional features that allow you to configure TDD subframes. It also provides tools to measure the On/Off Power.

R&S FSV/A-K105

The R&S FSV/A-K105 is designed to measure LTE TDD signals on the uplink.

The features are basically the same as in the R&S FSV/A-K101 with additional features that allow you to configure TDD subframes.

2.2 Installation

Find detailed installing instructions in the Getting Started or the release notes of the R&S FSV/A.

2.3 Starting the LTE measurement application

The LTE measurement application adds a new application to the R&S FSV/A.

To activate the application

1. Press the [MODE] key on the front panel of the R&S FSV/A.

   A dialog box opens that contains all operating modes and applications currently available on your R&S FSV/A.

2. Select the "LTE" item.

   The R&S FSV/A opens a new measurement channel for the LTE measurement application.

The measurement is started immediately with the default settings. It can be configured in the "Overview" dialog box, which is displayed when you select the "Overview" softkey from any menu.

For more information see Chapter 5, "Configuration", on page 49.

2.4 Understanding the display information

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.

1 = Toolbar
2 = Channel bar
3 = Diagram header
4 = Result display
5 = Tabs to select displayed information for multiple data streams
6 = Subwindows (if more than one data stream is displayed at the same time)
7 = Status bar
8 = Softkeys

Channel bar information

In the LTE measurement application, the R&S FSV/A shows the following settings:

Table 2-1: Information displayed in the channel bar in the LTE measurement application

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Frequency
Mode	LTE standard
MIMO	Number of Tx and Rx antennas in the measurement setup
Capture Time	Signal length that has been captured
Frame Count	Number of frames that have been captured
Selected Slot	Slot considered in the signal analysis
Selected Subframe	Subframe considered in the signal analysis

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S FSV/A Getting Started manual.

Window title bar information

The information in the window title bar depends on the result display.

The "Constellation Diagram", for example, shows the number of points that have been measured.

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram. Furthermore, the progress of the current operation is displayed in the status bar.

Regarding the synchronization state, the application shows the following labels.

- Sync OK
  The synchronization was successful. The status bar is green.
- Sync Failed
  The synchronization was not successful. The status bar is red.
  There can be three different synchronization errors.
  – Sync Failed (Cyclic Prefix): The cyclic prefix correlation failed.
  – Sync Failed (P-SYNC): The P-SYNC correlation failed.
  – Sync Failed (S-SYNC): The S-SYNC correlation failed.

3 Measurements and result displays

The LTE measurement application measures and analyzes various aspects of an LTE signal.

It features several measurements and result displays. Measurements represent different ways of processing the captured data during the digital signal processing. Result displays are different representations of the measurement results. They may be diagrams that show the results as a graph or tables that show the results as numbers.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 178

Result display selection: `LAYout:ADD[:WINDow]?` on page 121

3.1 Selecting measurements

Access: "Overview" > "Select Measurement"

The "Select Measurement" dialog box contains several buttons. Each button represents a measurement. A measurement in turn is a set of result displays that thematically belong together and that have a particular display configuration. If these predefined display configurations do not suit your requirements, you can add or remove result displays as you like. For more information about selecting result displays, see Chapter 3.2, "Selecting result displays", on page 14.

Depending on the measurement, the R&S FSV/A changes the way it captures and processes the raw signal data.

EVM

EVM measurements record, process and demodulate the signal's I/Q data. The result displays available for EVM measurements show various aspects of the LTE signal quality.

For EVM measurements, you can combine the result displays in any way.

For more information on the result displays, see Chapter 3.5, "Time alignment error measurements", on page 29.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 178

Time alignment error
Time alignment error (TAE) measurements record, process and demodulate the signal's I/Q data. The result displays available for TAE measurements indicate how well the antennas in a multi-antenna system are aligned.

For TAE measurements, you can combine the result displays in any way.

For more information on the result displays, see Chapter 3.5, "Time alignment error measurements", on page 29.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 178

Channel power ACLR
(inludes multi carrier ACLR and cumulative ACLR measurements)

ACLR measurements sweep the frequency spectrum instead of processing I/Q data.

The ACLR measurements evaluates the leakage ratio of neighboring channels and evaluates if the signal is within the defined limits. The measurement provides several result displays. You can combine the result displays in any way.

For more information on the result displays, see Chapter 3.6, "Frequency sweep measurements", on page 31.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 178

SEM
(inlcudes multi carrier SEM measurements)

SEM measurements sweep the frequency spectrum instead of processing I/Q data.

The SEM measurements tests the signal against a spectrum emission mask and evaluates if the signal is within the defined limits. The measurement provides several result displays. You can combine the result displays in any way.

For more information on the result displays, see Chapter 3.6, "Frequency sweep measurements", on page 31.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 178

3.2 Selecting result displays

Access:

The R&S FSV/A opens a menu (the SmartGrid) to select result displays. For more information on the SmartGrid functionality, see the R&S FSV/A Getting Started.

In the default state of the application, it shows several conventional result displays.

- Capture Buffer
- EVM vs Carrier
- Power Spectrum
- Result Summary

- Constellation Diagram

From that predefined state, add and remove result displays as you like from the Smart-Grid menu.

Remote command: `LAYout:ADD[:WINDow]?` on page 121

Measuring several data streams

When you capture more than one data stream (for example component carriers), each result display is made up out of several tabs.

The first tab shows the results for all data streams. The other tabs show the results for each individual data stream. By default, the tabs are coupled to one another - if you select a certain data stream in one display, the application also selects this data stream in the other result displays (see Subwindow Coupling).

The number of tabs depends on the number of data streams.

3.3 Performing measurements

By default, the application measures the signal continuously. In "Continuous Sweep" mode, the R&S FSV/A captures and analyzes the data again and again.

- For I/Q measurements, the amount of captured data depends on the capture time.
- For frequency sweep measurement, the amount of captured data depends on the sweep time.

In "Single Sweep" mode, the R&S FSV/A stops measuring after it has captured the data once. The amount of data again depends on the capture time.

Refreshing captured data

You can also repeat a measurement based on the data that has already been captured with the "Refresh" function. Repeating a measurement with the same data can be useful, for example, if you want to apply different modulation settings to the same I/Q data.

For more information, see the documentation of the R&S FSV/A.

3.4 I/Q measurements

Access: [MEAS] > "EVM/Frequency Err/Power"

You can select the result displays from the evaluation bar and arrange them as you like with the SmartGrid functionality.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 178

Result display selection: `LAYout:ADD[:WINDow]?` on page 121

Capture Buffer

The "Capture Buffer" shows the complete range of captured data for the last data capture.

The x-axis represents time. The maximum value of the x-axis is equal to the Capture Time.

The y-axis represents the amplitude of the captured I/Q data in dBm (for RF input).

The capture buffer uses the auto peak detector to evaluate the measurement data. The auto peak detector determines the maximum and the minimum value of the measured levels for each measurement point and combines both values in one sample point.

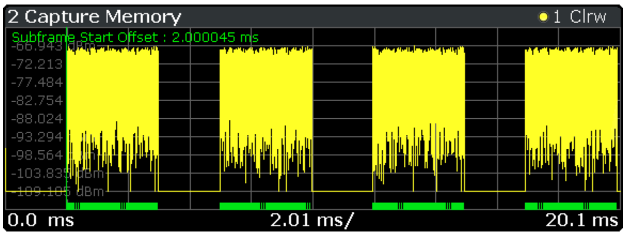


Figure 3-1: Capture buffer without zoom

A green vertical line at the beginning of the green bar in the capture buffer represents the subframe start. The diagram also contains the "Start Offset" value. This value is the time difference between the subframe start and capture buffer start.

When you zoom into the diagram, you will see that the bar is interrupted at certain positions. Each small bar indicates the useful parts of the OFDM symbol.

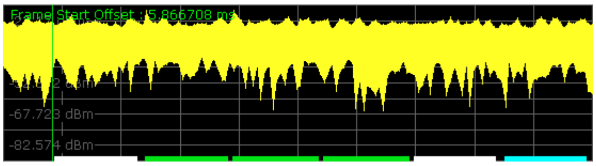


Figure 3-2: Capture buffer after a zoom has been applied

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CBUF`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144
Subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?` on page 154

EVM vs Carrier

The "EVM vs Carrier" result display shows the error vector magnitude (EVM) of the subcarriers. With the help of a marker, you can use it as a debugging technique to identify any subcarriers whose EVM is too high.

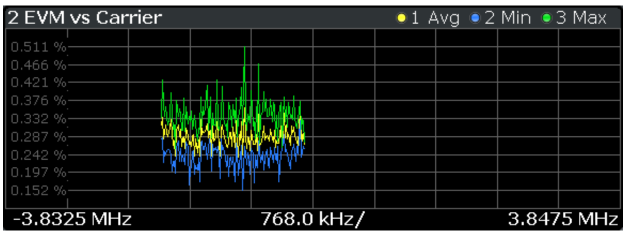
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed slot in the capture buffer.

If you analyze all slots, the result display contains three traces.

- Average EVM
  This trace shows the subcarrier EVM, averaged over all slots.
- Minimum EVM
  This trace shows the lowest (average) subcarrier EVM that has been found over the analyzed slots.
- Maximum EVM
  This trace shows the highest (average) subcarrier EVM that has been found over the analyzed slots.

If you select and analyze one slot only, the result display contains one trace that shows the subcarrier EVM for that slot only. Average, minimum and maximum values in that case are the same. For more information, see "Slot Selection" on page 105.

The x-axis represents the center frequencies of the subcarriers. The y-axis shows the EVM in % or in dB, depending on the EVM Unit.



Remote command:
Selection `LAY:ADD ? '1',LEFT,EVCA`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144

EVM vs Symbol

The "EVM vs Symbol" result display shows the error vector magnitude (EVM) of the OFDM symbols. You can use it as a debugging technique to identify any symbols whose EVM is too high.

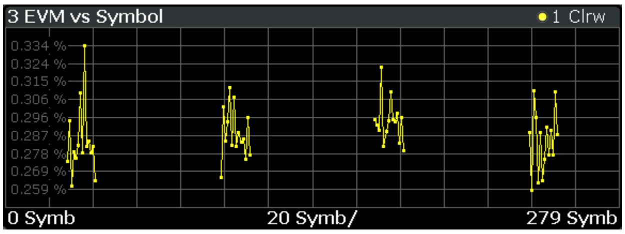
The results are based on an average EVM that is calculated over all subcarriers that are part of a certain OFDM symbol. This average OFDM symbol EVM is determined for all OFDM symbols in each analyzed slot.

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. Any missing connections from one dot to another mean that the R&S FSV/A could not determine the EVM for that symbol.

The number of displayed symbols depends on the subframe selection and the length of the cyclic prefix.

For TDD signals, the result display does not show OFDM symbols that are not part of the measured link direction.

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSY`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144

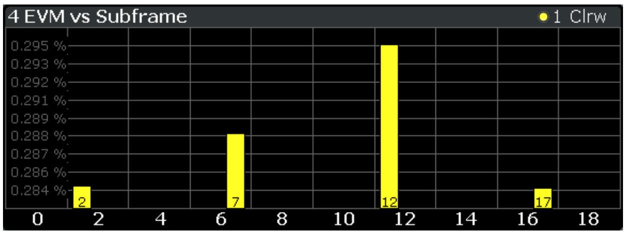
EVM vs Subframe

The "EVM vs Subframe" result display shows the Error Vector Magnitude (EVM) for each subframe. You can use it as a debugging technique to identify a subframe whose EVM is too high.

The result is an average over all subcarriers and symbols of a specific subframe.

The x-axis represents the subframes, with the number of displayed subframes being 10.

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.

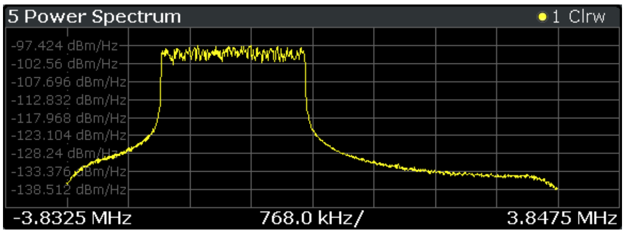


Remote command:
Selection: LAY:ADD ? '1',LEFT,EVSU
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 144

Power Spectrum
The "Power Spectrum" shows the power density of the complete capture buffer in dBm/Hz.

The displayed bandwidth depends on the selected channel bandwidth.

The x-axis represents the frequency. On the y-axis, the power level is plotted.



Remote command:
Selection: LAY:ADD ? '1',LEFT,PSPE
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 144

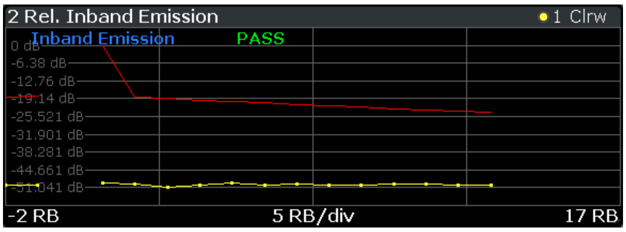
Inband Emission
The "Inband Emission" result display shows the power of the unused resource blocks relative to the allocated resource blocks (yellow trace). The diagram also shows the inband emission limit lines (red trace). The allocated resource blocks are not evaluated.

The x-axis represents the resource blocks. The numbering of the resource blocks is based on 3GPP 38.521 as a function of the resource block offset from the edge of the allocated uplink transmission bandwidth.

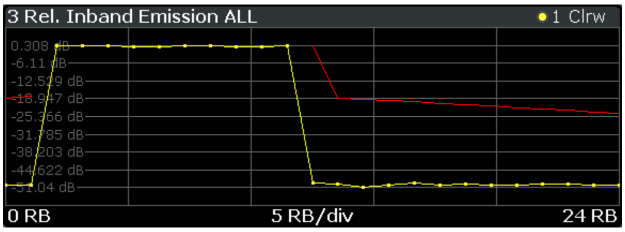
The y-axis shows the measured power for each resource block.

Because the measurement is evaluated over a single slot in the currently selected subframe, you have to select a specific slot and subframe to get valid measurement results.

Limits for the inband emission are specified in 3GPP 36.101.



You can also display the inband emissions for the allocated resource block in addition to the unused resource blocks when you select the "Inband Emissions All" result display.



Remote command:
Selection: LAY:ADD ? '1',LEFT,IE
Selection: LAY:ADD ? '1',LEFT,IEA
Query (y-axis): TRACe:DATA?
Query (x-axis): TRACe<n>[:DATA]:X? on page 144

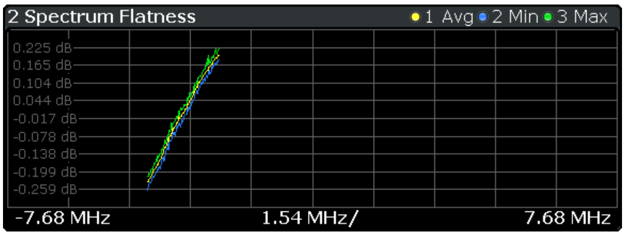
Spectrum Flatness

The "Spectrum Flatness" result display shows the relative power offset caused by the transmit channel.

The measurement is evaluated over the currently selected slot in the currently selected subframe.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the channel flatness is plotted in dB.



Note that the limit lines are only displayed if you match the Operating Band to the center frequency. Limits are defined for each operating band in the standard.

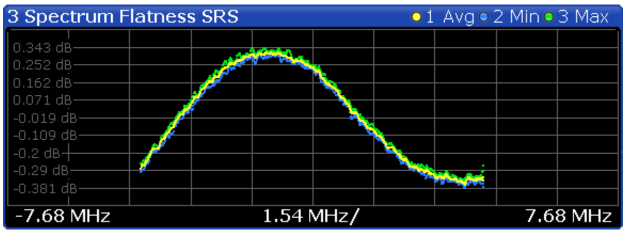
The shape of the limit line is different when "Extreme Conditions" on page 59 are on.

Remote command:
Selecting the result display: LAY:ADD ? '1',LEFT,SFL
Querying results:
TRACe:DATA?
TRACe<n>[:DATA]:X? on page 144

Spectrum Flatness SRS

The "Spectrum Flatness SRS" display shows the amplitude of the channel transfer function based on the sounding reference signal.

The measurement is evaluated over the currently selected slot in the currently selected subframe. The slot and subframe selection may be changed in the general settings.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,SFSR`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144

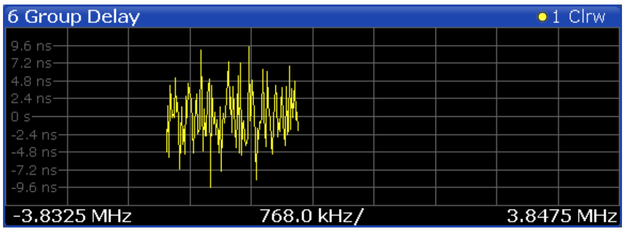
Group Delay

This "Group Delay" shows the group delay of each subcarrier.

The measurement is evaluated over the currently selected slot in the currently selected subframe.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the group delay is plotted in ns.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,GDEL`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144

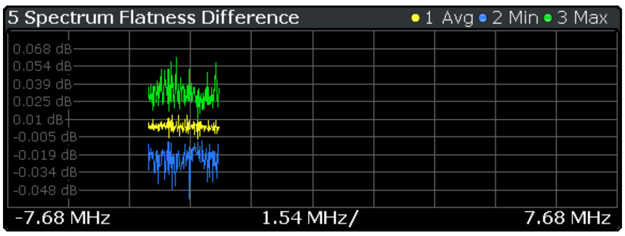
Spectrum Flatness Difference

The "Spectrum Flatness Difference" result display shows the level difference in the spectrum flatness result between two adjacent physical subcarriers.

The measurement is evaluated over the currently selected slot in the currently selected subframe.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the power is plotted in dB.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,SFD`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 144

Constellation Diagram

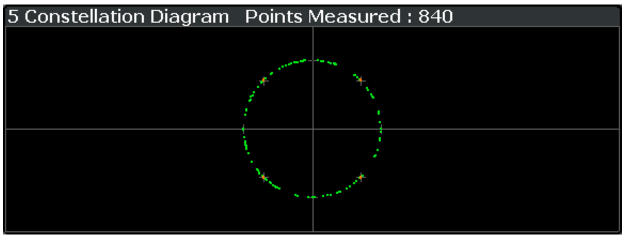
The "Constellation Diagram" shows the in-phase and quadrature phase results and is an indicator of the quality of the modulation of the signal.

In the default state, the result display evaluates the full range of the measured input data.

Each color represents a modulation type.

- : RBPSK
- : MIXTURE
- : QPSK
- : 16QAM
- : 64QAM
- : 256QAM
- : PSK (CAZAC)

You can filter the results by changing the evaluation range.



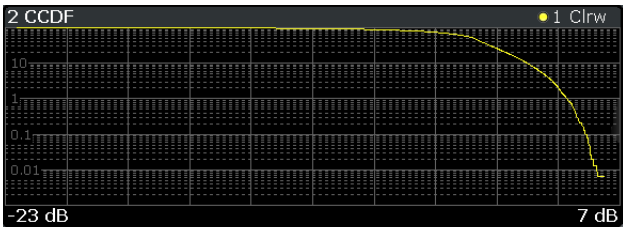
The constellation diagram also contains information about the current evaluation range, including the number of points that are displayed in the diagram.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CONS`
Query: TRACe:DATA?

CCDF

The "Complementary Cumulative Distribution Function (CCDF)" shows the probability of an amplitude exceeding the mean power. For the measurement, the complete capture buffer is used.

The x-axis represents the power relative to the measured mean power. On the y-axis, the probability is plotted in %.



In addition to the diagram, the results for the CCDF measurement are summarized in the CCDF table.

Mean	Mean power
Peak	Peak power
Crest	Crest factor (peak power – mean power)
10 %	10 % probability that the level exceeds mean power + [x] dB
1 %	1 % probability that the level exceeds mean power + [x] dB
0.1 %	0.1 % probability that the level exceeds mean power + [x] dB
0.01 %	0.01 % probability that the level exceeds mean power + [x] dB

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CCDF`
Query (y-axis): TRACe:DATA?
Numerical results: `CALCulate<n>:STATistics:CCDF:X<t>?` on page 160
Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 160

Allocation Summary
The "Allocation Summary" shows various parameters of the measured allocations in a table.

Each row in the allocation table corresponds to an allocation. A set of several allocations make up a subframe. A horizontal line indicates the beginning of a new subframe.

4 Allocation Summary

Sub-Frame	Allocation ID	No. of RBs	Offset RB	Modulation	Power [dBm]	EVM [%]
2	PUSCH	10	2	QPSK	-30.020	0.285
	DMRS PUSCH			CAZAC	-30.020	0.292
7	PUSCH	10	2	QPSK	-30.019	0.287
	DMRS PUSCH			CAZAC	-30.017	0.297

The columns of the table show the following properties for each allocation.
- The location of the allocation (subframe number).
- The ID of the allocation (channel type).
- Number of resource blocks used by the allocation.
- The resource block offset of the allocation.
- The modulation of the allocation.
- The power of the allocation in dBm.
- The EVM of the allocation.
  The unit depends on the EVM unit

Click **once** on the header row to open a dialog box that allows you to add and remove columns.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,ASUM`
Query: TRACe:DATA?

Bitstream
The "Bitstream" shows the demodulated data stream for the data allocations.

At the end of the table is a summary of the bitstream for certain configurations.

- Total number of bits or symbols
- Total number of coded bits
- Total number of bit errors
- Bit error rate (BER) in percent
- Bits per second (= coded bits - bit errors)
  The totals are calculated over all PUSCH allocations that contribute to the bit-stream. If the crc fails for one of the allocations, the R&S FSV/A returns NAN for the total numbers.

The bitstream summary is displayed under the following conditions.

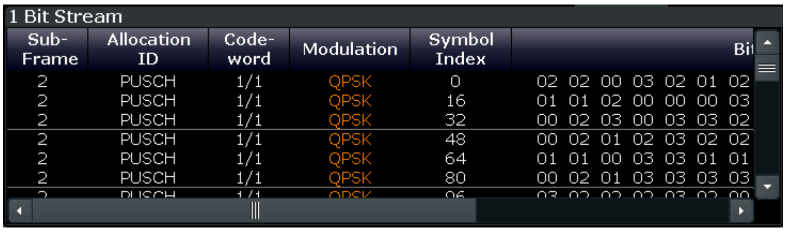
- Select an ORAN test case.

Depending on the bitstream format, the numbers represent either bits (bit order) or symbols (symbol order).

- For the bit format, each number represents one raw bit.
- For the symbol format, the bits that belong to one symbol are shown as hexadecimal numbers with two digits.

Resource elements that do not contain data or are not part of the transmission are represented by a "-".

If a symbol could not be decoded because the number of layers exceeds the number of receive antennas, the application shows a "#" sign.



The table contains the following information:

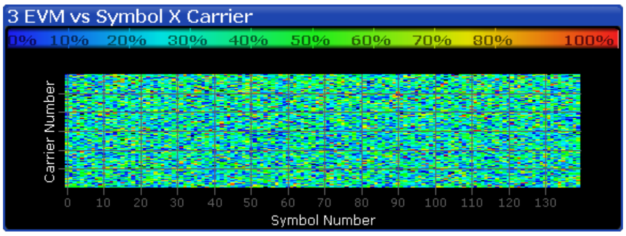
- **Subframe**
  Number of the subframe the bits belong to.
- **Allocation ID**
  Channel the bits belong to.
- **Codeword**
  Code word of the allocation.
- **Modulation**
  Modulation type of the channels.
- **Symbol Index** or **Bit Index**
  Indicates the position of the table row's first bit or symbol within the complete stream.
- **Bit Stream**
  The actual bit stream.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,BSTR`
Query: TRACe:DATA?

EVM vs Symbol x Carrier

The "EVM vs Symbol x Carrier" result display shows the EVM for each carrier in each symbol.

The x-axis represents the symbols. The y-axis represents the subcarriers. Different colors in the diagram area represent the EVM. A color map in the diagram header indicates the corresponding power levels.

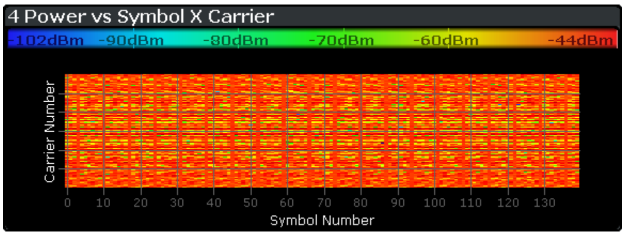


Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSC`
Query: TRACe:DATA?

Power vs Symbol x Carrier

The "Power vs Symbol x Carrier" result display shows the power for each carrier in each symbol.

The x-axis represents the symbols. The y-axis represents the subcarriers. Different colors in the diagram area represent the power. A color map in the diagram header indicates the corresponding power levels.



Remote command:
Selection: `LAY:ADD ? '1',LEFT,PVSC`
Query: TRACe:DATA?

Result Summary

The Result Summary shows all relevant measurement results in numerical form, combined in one table.

Remote command:

`LAY:ADD ? '1',LEFT,RSUM`

Contents of the result summary

The contents of the result summary depend on the analysis mode you have selected. The first screenshot shows the results for "PUSCH/PUCCH" analysis mode, the second one those for "PRACH" analysis mode.

4 Result Summary				
Frame Results 30/30	**Mean**	**Limit**	**Max**	**Min**
EVM PUSCH QPSK (%)	0.30	17.50		
EVM PUSCH 16QAM (%)		12.50		
EVM DMRS PUSCH QPSK (%)	0.35	17.50		
EVM DMRS PUSCH 16QAM (%)		12.50		
EVM PUCCH (%)		17.50		
EVM DMRS PUCCH (%)		17.50		
Results for Selection	**Subframe(s) ALL**	**Slot(s) ALL**	**Frame Results 30/30**	
EVM All (%)	0.29		0.30	0.28
EVM Phys. Channel (%)	0.29		0.30	0.27
EVM Phys. Signal (%)	0.28		0.31	0.25
Frequency Error (Hz)	-26.65		-26.05	-27.29
Sampling Error (ppm)				
IQ Offset (dB)	-67.10		-63.11	-74.13
IQ Gain Imbalance (dB)				
IQ Quadrature Error (°)				
Power (dBm)	-30.02		-30.02	-30.02
Crest Factor (dB)	5.76		6.21	5.35

Figure 3-3: Result summary in PUSCH/PUCCH analysis mode

4 Result Summary				
3GPP EVM Results	**Mean**	**Limit**	**Max**	**Min**
EVM PRACH (%)	0.22	17.50		
Results for Selection	**Preamble ALL**		**Preamble Count 2/2**	
EVM All (%)	0.22		0.22	0.22
Frequency Error (Hz)	-26.91		-26.77	-27.04
Sampling Error (ppm)				
IQ Offset (dB)	-127.79		-127.70	-127.88
IQ Gain Imbalance (dB)				
IQ Quadrature Error (°)				
Power (dBm)	-26.59		-26.59	-26.59
Crest Factor (dB)	4.50		4.51	4.49

Figure 3-4: Result summary in PRACH analysis mode

The table is split in two parts. The first part shows results that refer to the complete frame. It also indicates limit check results where available. The font of 'Pass' results is green and that of 'Fail' results is red.

In addition to the red font, the application also puts a red star (* 25.60) in front of failed results.

The second part of the table shows results that refer to a specific selection of the frame. The statistic is always evaluated over the slots. The header row of the table contains information about the selection you have made (like the subframe).

Note: The EVM results on a frame level (first part of the table) are calculated as defined by 3GPP at the edges of the cyclic prefix.
The other EVM results (lower part of the table) are calculated at the optimal timing position in the middle of the cyclic prefix.

Because of inter-symbol interference, the EVM calculated at the edges of the cyclic prefix is higher than the EVM calculated in the middle of the cyclic prefix.

By default, all EVM results are in %. To view the EVM results in dB, change the EVM Unit.

Table 3-1: Result summary: part containing results as defined by 3GPP (PUSCH/PUCCH analysis)

EVM PUSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the PUSCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:USQP[:AVERage]?` on page 149
EVM PUSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the PUSCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:USST[:AVERage]?` on page 149
EVM PUSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the PUSCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:USSF[:AVERage]?` on page 149
EVM PUSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the PUSCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:USTS[:AVERage]?` on page 150
EVM DMRS PUSCH QPSK	Shows the EVM of all DMRS resource elements with QPSK modulation of the PUSCH in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:SDQP[:AVERage]?` on page 147
EVM DMRS PUSCH 16QAM	Shows the EVM of all DMRS resource elements with 16QAM modulation of the PUSCH in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:SDST[:AVERage]?` on page 147
EVM DMRS PUSCH 64QAM	Shows the EVM of all DMRS resource elements with 64QAM modulation of the PUSCH in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:SDSF[:AVERage]?` on page 147
EVM DMRS PUSCH 256QAM	Shows the EVM of all DMRS resource elements with 256QAM modulation of the PUSCH in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:SDTS[:AVERage]?` on page 148
EVM PUCCH	Shows the EVM of all resource elements of the PUCCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:UCCH[:AVERage]?` on page 148
EVM DMRS PUCCH	Shows the EVM of all DMRS resource elements of the PUCCH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:UCCD[:AVERage]?` on page 148

Table 3-2: Result summary: part containing results as defined by 3GPP (PRACH analysis)

EVM PRACH	Shows the EVM of all resource elements of the PRACH channel in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM:UPRA[:AVERage]?` on page 148

Table 3-3: Result summary: part containing results for a specific selection

EVM All	Shows the EVM for all resource elements in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?` on page 151
EVM Phys Channel	Shows the EVM for all physical channel resource elements in the analyzed frame. A physical channel corresponds to a set of resource elements carrying information from higher layers. PUSCH, PUCCH and PRACH are physical channels. For more information, see 3GPP 36.211. `FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?` on page 151 ("PUSCH/PUCCH" analysis mode only.)
EVM Phys Signal	Shows the EVM for all physical signal resource elements in the analyzed frame. The reference signal is a physical signal. For more information, see 3GPP 36.211. `FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?` on page 152 ("PUSCH/PUCCH" analysis mode only.)
Frequency Error	Shows the difference in the measured center frequency and the reference center frequency. `FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?` on page 152
Sampling Error	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. `FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?` on page 154
I/Q Offset	Shows the power at spectral line 0 normalized to the total transmitted power. `FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?` on page 153
I/Q Gain Imbalance	Shows the logarithm of the gain ratio of the Q-channel to the I-channel. `FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]?` on page 152
I/Q Quadrature Error	Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees. `FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]?` on page 154
Power	Shows the average time domain power of the allocated resource blocks of the analyzed signal. `FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?` on page 153
Crest Factor	Shows the peak-to-average power ratio of captured signal. `FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?` on page 150

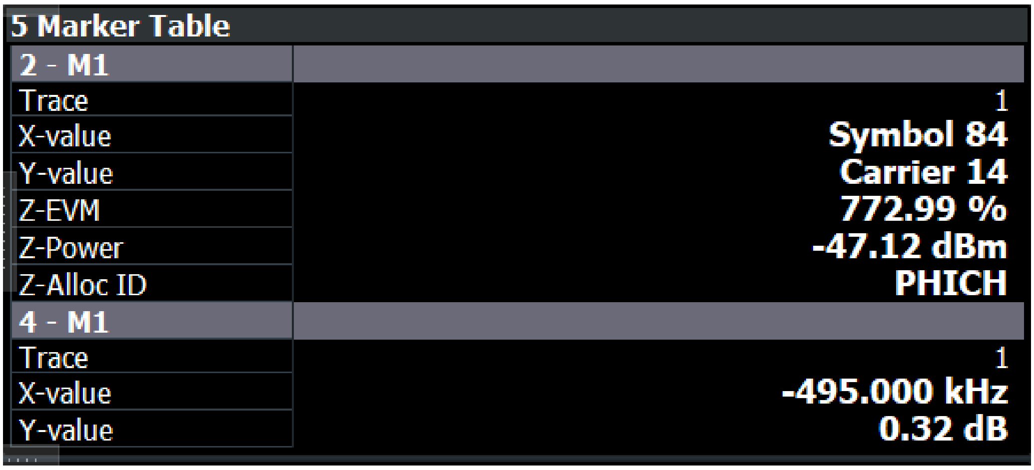
Marker Table

Displays a table with the current marker values for the active markers.

This table is displayed automatically if configured accordingly.

Wnd	Shows the window the marker is in.
Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Trc	Shows the trace that the marker is positioned on.
Ref	Shows the reference marker that a delta marker refers to.

X- / Y-Value	Shows the marker coordinates (usually frequency and level).
Z-EVM **Z-Power** **Z-Alloc ID**	Shows the "EVM", power and allocation type at the marker position. Only in 3D result displays (for example "EVM vs Symbol x Carrier").



Tip: To navigate within long marker tables, simply scroll through the entries with your finger on the touchscreen.

Remote command:
`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 121
Results:
`CALCulate<n>:MARKer<m>:X` on page 157
`CALCulate<n>:MARKer<m>:Y` on page 158
`CALCulate<n>:MARKer<m>:Z?` on page 159
`CALCulate<n>:MARKer<m>:Z:ALL?` on page 159

3.5 Time alignment error measurements

Access: [MEAS] > "Time Alignment Error"

The time alignment error measurement captures and analyzes new I/Q data when you select it.

Note that the time alignment error measurement only work in a MIMO setup (2 or 4 antennas) or a system with component carriers. Therefore, you have to mix the signal of the antennas into one cable that you can connect to the R&S FSV/A. For more information on configuring and performing a time alignment error measurement see Chapter 4.4, "Performing time alignment measurements", on page 45.

In addition to the result displays mentioned in this section, the time alignment error measurement also supports the following result displays described elsewhere.

- "Capture Buffer" on page 16

- "Power Spectrum" on page 19
- "Marker Table" on page 28

You can select the result displays from the evaluation bar and arrange them as you like with the SmartGrid functionality.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 178

Result display selection: `LAYout:ADD[:WINDow]?` on page 121

Time Alignment Error

The time alignment is an indicator of how well the transmission antennas in a MIMO system and component carriers are synchronized. The time alignment error is either the time delay between a reference antenna (for example antenna 1) and another antenna or the time delay between a reference component carrier and other component carriers.

The application shows the results in a table.

Each row in the table represents one antenna. The reference antenna is not shown.

For each antenna, the maximum, minimum and average time delay that has been measured is shown. The minimum and maximum results are calculated only if the measurement covers more than one subframe.

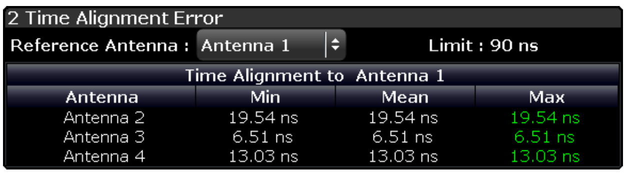
If you perform the measurement on a system with carrier aggregation, each row represents one antenna. The number of lines increases because of multiple carriers. The reference antenna of the main component carrier (CC1) is not shown.

In case of carrier aggregation, the time alignment error measurement also evaluates the "Carrier Frequency Error" on page 31 of the component carrier (CC2) relative to the main component carrier (CC1).

In any case, results are only displayed if the transmission power of both antennas is within 15 dB of each other. Likewise, if only one antenna transmits a signal, results will not be displayed (for example if the cabling on one antenna is faulty).

For more information on configuring this measurement see Chapter 5.3, "Time alignment error measurements", on page 95.

The "Limit" value shown in the result display is the maximum time delay that may occur for each antenna (only displayed for systems without carrier aggregation).



You can select the reference antenna from the dropdown menu in the result display. You can also select the reference antenna in the MIMO Setup - if you change them in one place, they are also changed in the other.

In the default layout, the application also shows the "Capture Buffer" and "Power Spectrum" result displays for each component carrier.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,TAL`
Query: `FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?` on page 156

Carrier Frequency Error
The "Carrier Frequency Error" shows the frequency deviation between a reference carrier (usually component carrier 1) and another component carrier. It is an indicator of how well the component carriers in a system with carrier aggregation are synchronized.

The application shows the results in a table.

For each component carrier, the application adds two rows to the table.

- The first row shows the lowest, average and highest frequency error that has been measured **in Hz**. In addition, the limit defined by 3GPP for that scenario is displayed. Note that the application always tests against the highest measured value; if the limit has been violated, the font color of the maximum value turns red.
  If you measure a single slot only, the lowest, average and highest valued are the same.
- The second row shows the lowest, average and highest frequency error that has been measured **in ppm**. In addition, the limit defined by 3GPP for that scenario is displayed.
  If you measure a single slot only, the lowest, average and highest valued are the same.

The reference component carrier is not represented in the table.

Remote command:
In Hz: `FETCh:FERRor[:CC<cc>][:AVERage]?` on page 155
In ppm: `FETCh:FEPPm[:CC<cc>][:AVERage]?` on page 155

3.6 Frequency sweep measurements

Access (ACLR): [MEAS] > "Channel Power ACLR"

Access (MC ACLR): [MEAS] > "Multi Carrier ACLR"

Access (SEM): [MEAS] > "Spectrum Emission Mask"

The LTE aplication supports the following frequency sweep measurements.

- Adjacent channel leakage ratio (ACLR)
- Spectrum emission mask (SEM)

Instead of using I/Q data, the frequency sweep measurements sweep the spectrum every time you run a new measurement. Therefore, it is mandatory to feed a signal into the RF input for these measurements. Using previously acquired I/Q data for the frequency sweep measurements is not possible (and vice-versa).

Because each of the frequency sweep measurements uses different settings to obtain signal data it is also not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.

Make sure to have sufficient bandwidth to be able to capture the whole signal, including neighboring channels.

In addition to the specific diagrams and table (see description below), frequency sweep measurements support the following result displays.

- "Marker Table" on page 28
- Marker peak list
  Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 178

Result display selection: `LAYout:ADD[:WINDow]?` on page 121

Adjacent Channel Leakage Ratio (ACLR)
The adjacent channel leakage ratio (ACLR) measurement is designed to analyze signals that contain multiple signals for different radio standards. Using the ACLR measurement, you can determine the power of the transmit (Tx) channel and the power of the neighboring (adjacent) channels to the left and right of the Tx channel. Thus, the ACLR measurement provides information about the power in the adjacent channels as well as the leakage into these adjacent channels.

When you measure the ACLR in the LTE application, the R&S FSV/A automatically selects appropriate ACLR settings based on the selected channel bandwidth.

For a comprehensive description of the ACLR measurement, refer to the user manual of the R&S FSV/A.

Remote command:
Selection: `CONF:MEAS ACLR`

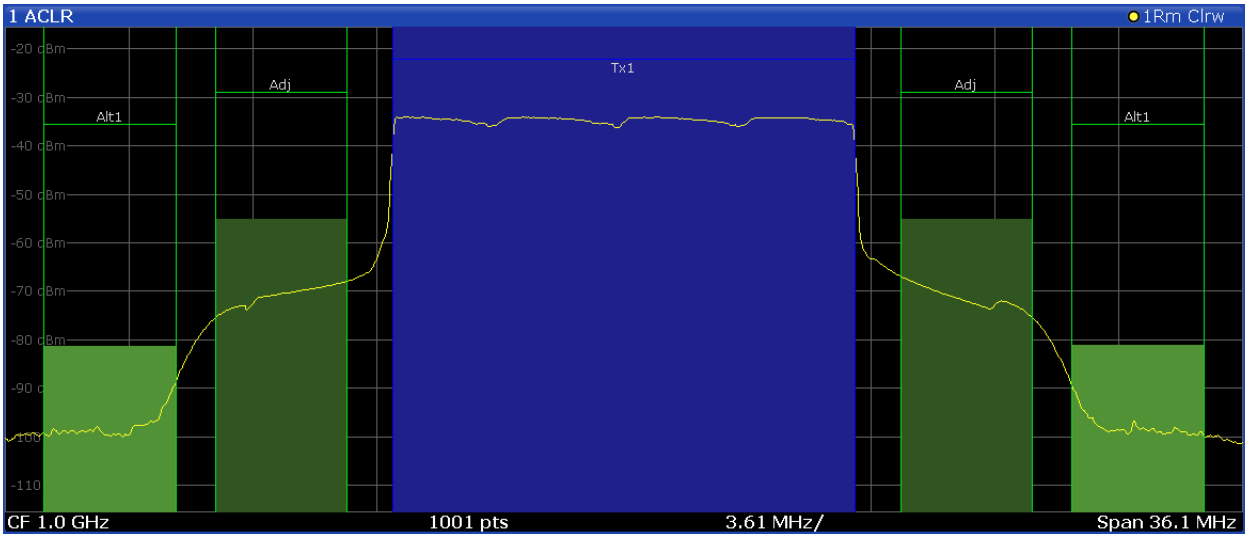
Result diagram ← Adjacent Channel Leakage Ratio (ACLR)
The result diagram is a graphic representation of the signals with a trace that shows the measured signal. Individual channels (Tx and adjacent channels) are indicated by vertical lines and corresponding labels.

In addition, the R&S FSV/A highlights the channels (blue: Tx channel, green: adjacent channels).

The x-axis represents the frequency with a frequency span that relates to the specified LTE channel and adjacent channel bandwidths. On the y-axis, the power is plotted in dBm.

The power for the Tx channel is an absolute value in dBm. The power of the adjacent channels is relative to the power of the Tx channel.

In addition, the R&S FSV/A tests the ACLR measurement results against the limits defined by 3GPP.



Remote command:
Result query: TRACe:DATA?

Result summary ← Adjacent Channel Leakage Ratio (ACLR)
The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain channel type (Tx, adjacent channel). The columns contain the channel characteristics.

- **Channel**
  Shows the channel type (Tx, adjacent or alternate channel).
- **Bandwidth**
  Shows the channel bandwidth.
- **Offset**
  Shows the channel spacing.
- **Power**
  Shows the power of the Tx channel.
- **Lower / Upper**
  Shows the relative power of the lower and upper adjacent and alternate channels. The values turn red if the power violates the limits.
- **Limit**
  Shows the limit of that channel, if one is defined.

2 Result Summary — EUTRA/LTE Square/RRC

Channel	Bandwidth	Offset	Power	
Tx1 (Ref)	13.500 MHz		-13.56 dBm	
Tx Total			-13.56 dBm	
Channel	**Bandwidth**	**Offset**	**Lower**	**Upper**
Adj	3.840 MHz	10.000 MHz	-41.48 dB	-41.66 dB
Alt1	3.840 MHz	15.000 MHz	-67.74 dB	-67.62 dB

Remote command:
Result query: CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?

Spectrum Emission Mask (SEM)
Note: The SEM measurement also supports carrier aggregation up to two contiguous component carriers. You can configure the component carriers in the Carrier Aggregation panel.

The "Spectrum Emission Mask" (SEM) measurement shows the quality of the measured signal by comparing the power values in the frequency range near the carrier against a spectral mask that is defined by the 3GPP specifications. In this way, you can test the performance of the DUT and identify the emissions and their distance to the limit.

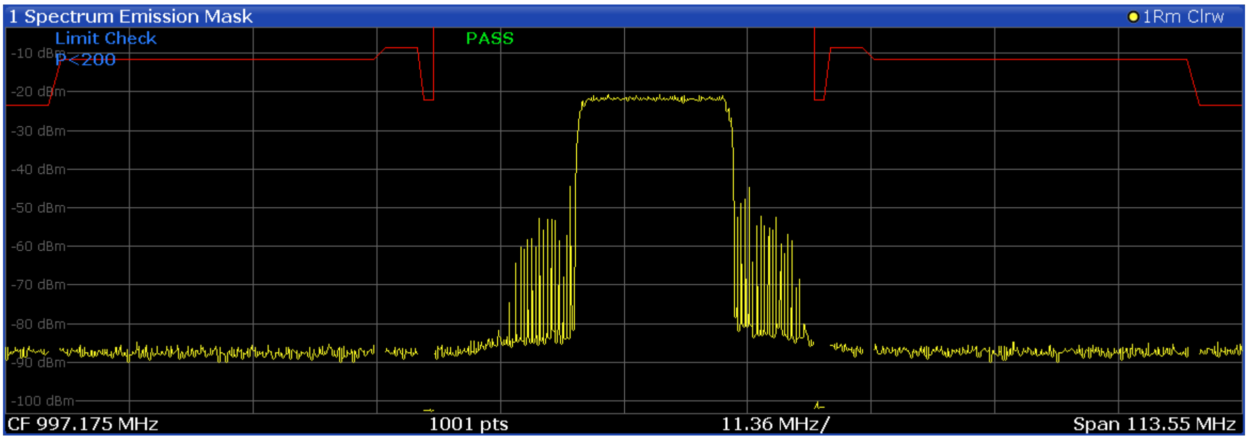
For a comprehensive description of the SEM measurement, refer to the user manual of the R&S FSV/A.

Remote command:
Selection (SEM): CONF:MEAS ESP
Selection (Multi-SEM): CONF:MEAS MCES

Result diagram ← Spectrum Emission Mask (SEM)
The result diagram is a graphic representation of the signal with a trace that shows the measured signal. The SEM is represented by a red line.

If any measured power levels are above that limit line, the test fails. If all power levels are inside the specified limits, the test passes. The application labels the limit line to indicate whether the limit check has passed or failed.

The x-axis represents the frequency with a frequency span that relates to the specified LTE channel bandwidths. The y-axis shows the signal power in dBm.



Remote command:
Result query: TRACe:DATA?

Result summary ← Spectrum Emission Mask (SEM)
The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain SEM range. The columns contain the range characteristics. If a limit fails, the range characteristics turn red.

- **Start / Stop Freq Rel**
  Shows the start and stop frequency of each section of the spectrum emission mask relative to the center frequency.
- **RBW**
  Shows the resolution bandwidth of each section of the spectrum emission mask.
- **Freq at Δ to Limit**
  Shows the absolute frequency whose power measurement being closest to the limit line for the corresponding frequency segment.
- **Power Abs**
  Shows the absolute measured power of the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.
- **Power Rel**
  Shows the distance from the measured power to the limit line at the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.
- **Δ to Limit**
  Shows the minimal distance of the tolerance limit to the SEM trace for the corresponding frequency segment. Negative distances indicate that the trace is below the tolerance limit, positive distances indicate that the trace is above the tolerance limit.

2 Result Summary
Sub Block A — Center 997.18 MHz — Tx Power -10.69 dBm — Tx Bandwidth 34.850 MHz — RBW 30.000 kHz — LTE UL

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-56.775 MHz	-52.775 MHz	1.000 MHz	942.78889 MHz	-85.96 dBm	-75.26 dB	-62.46 dB
-51.775 MHz	-22.925 MHz	1.000 MHz	972.13506 MHz	-85.54 dBm	-74.85 dB	-74.04 dB
-21.925 MHz	-18.925 MHz	1.000 MHz	977.86111 MHz	-86.04 dBm	-75.35 dB	-77.54 dB
-18.410 MHz	-17.440 MHz	30.000 kHz	979.43187 MHz	-102.33 dBm	-91.64 dB	-80.33 dB
17.440 MHz	18.410 MHz	30.000 kHz	1.01492 GHz	-100.40 dBm	-89.70 dB	-78.40 dB
18.925 MHz	21.925 MHz	1.000 MHz	1.01671 GHz	-85.18 dBm	-74.49 dB	-76.68 dB
22.925 MHz	51.775 MHz	1.000 MHz	1.03284 GHz	-84.80 dBm	-74.11 dB	-73.30 dB
52.775 MHz	56.775 MHz	1.000 MHz	1.05167 GHz	-84.80 dBm	-74.11 dB	-61.30 dB

Multi Carrier ACLR (MC ACLR)

The MC ACLR measurement is basically the same as the Adjacent Channel Leakage Ratio (ACLR) measurement: it measures the power of the transmission channels and neighboring channels and their effect on each other. Instead of measuring a single carrier, the MC ACLR measures two contiguous component carriers. You can configure the component carriers in the Carrier Aggregation panel. Note that the component carriers have to be next to each other.

In its default state, the MC ACLR measurement measures three neighboring channels above and below the carrier. One of the neighboring channels is assumed to be an EUTRA channel (for example LTE) and the other two are assumed to be UTRA channels (for example WCDMA). Note that you can configure a different neighboring channel setup with the tools provided by the measurement. These tools are the same as those provided in the spectrum application. For more information, please refer to the documentation of the R&S FSV/A.

The configuration in its default state complies with the test specifications defined in 3GPP 36.521.

Remote command:
Selection: `CONF:MEAS MCAC`

Result diagram ← Multi Carrier ACLR (MC ACLR)
The result diagram is a graphic representation of the signals with a trace that shows the measured signal. Individual channels (Tx and adjacent channels) are indicated by vertical lines and corresponding labels.

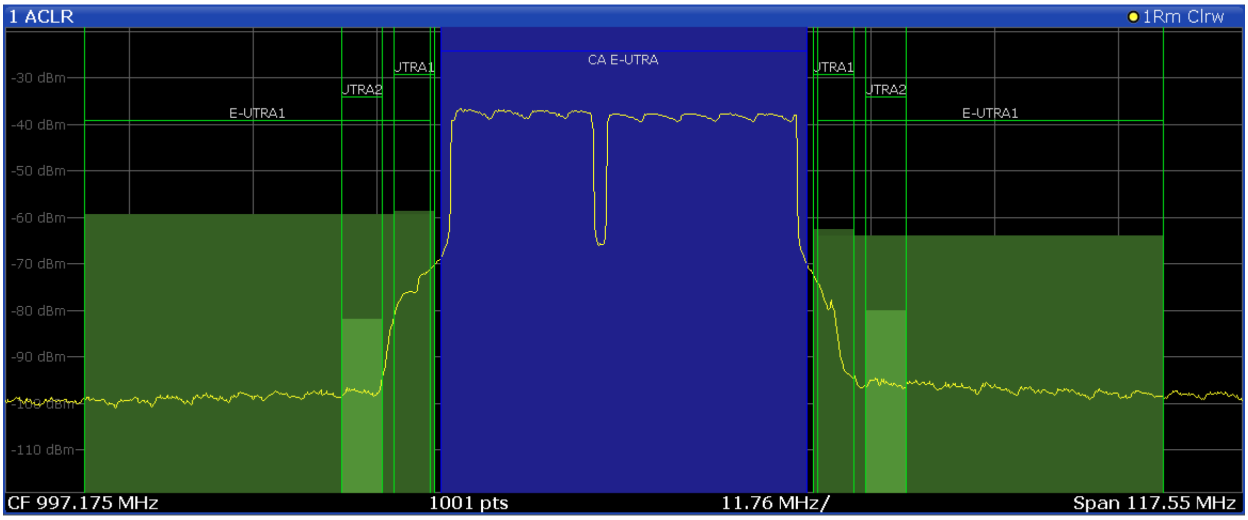
In addition, the R&S FSV/A highlights the channels (blue: Tx channel, green: adjacent channels).

The x-axis represents the frequency with a frequency span that relates to the LTE channel characteristics and adjacent channel bandwidths. Note that the application automatically determines the center frequency of the measurement according to the frequencies of the carriers.

On the y-axis, the power is plotted in dBm. The power for the TX channels is an absolute value in dBm. The powers of the adjacent channels are values relative to the power of the TX channel. The power of the channels is automatically tested against the limits defined by 3GPP.

The result display contains several additional elements.

- Blue and green lines:
  Represent the bandwidths of the carriers (blue lines) and those of the neighboring channels (green lines). Note that the channels can overlap each other.
- Blue and green bars:
  Represent the integrated power of the transmission channels (blue bars) and neighboring channels (green bars).



Remote command:
TRACe:DATA?

Result summary ← Multi Carrier ACLR (MC ACLR)
The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain channel type (Tx, adjacent channel). The columns contain the channel characteristics.

A table above the result display contains information about the measurement in numerical form:

- **Channel**
  Shows the type of channel.

The first rows represent the aggregated carrier ("CA EUTRA Ref" and "Total": they show the characteristics of the aggregated channel and thus are basically the same). Regarding its characteristics, the two carriers are regarded as a single channel.
The other rows represent the neighboring channels (one E-UTRA and two UTRA channels).
The other rows represent the neighboring channels (Adj Lower / Upper and Alt1 Lower / Upper).

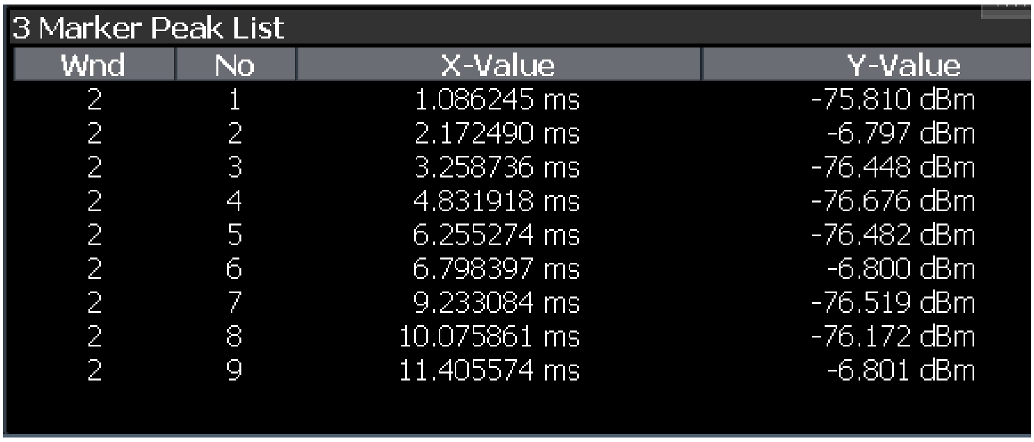
- **Bandwidth**
  Shows the bandwidth of the channel.
  The bandwidth of the carrier is the sum of the two component carriers.
- **Offset**
  Frequency offset relative to the center frequency of the aggregated carrier.
- **Power / Lower / Upper / Gap**
  Shows the power of the carrier and the power of the lower and upper neighboring channels relative to the power of the aggregated carrier.

2 Result Summary		LTE Carrier Aggregation		
Channel	Bandwidth	Offset	Power	
CA E-UTRA (Ref)	34.850 MHz		-13.19 dBm	
Tx Total			-13.19 dBm	
Channel	Bandwidth	Offset	Lower	Upper
UTRA1	3.840 MHz	19.925 MHz	-45.42 dB	-49.33 dB
UTRA2	3.840 MHz	24.925 MHz	-68.67 dB	-66.96 dB
E-UTRA1	32.850 MHz	34.850 MHz	-46.26 dB	-50.88 dB

Note that the font of the results turns red if the signal violates the limits defined by 3GPP.

Remote command:
Result query: `CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]?` on page 145
Limit check adjacent: `CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult?` on page 161
Limit check alternate: `CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult?` on page 163

Marker Peak List
The marker peak list determines the frequencies and levels of peaks in the spectrum or time domain. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.



3 Marker Peak List

Wnd	No	X-Value	Y-Value
2	1	1.086245 ms	-75.810 dBm
2	2	2.172490 ms	-6.797 dBm
2	3	3.258736 ms	-76.448 dBm
2	4	4.831918 ms	-76.676 dBm
2	5	6.255274 ms	-76.482 dBm
2	6	6.798397 ms	-6.800 dBm
2	7	9.233084 ms	-76.519 dBm
2	8	10.075861 ms	-76.172 dBm
2	9	11.405574 ms	-6.801 dBm

Tip: To navigate within long marker peak lists, simply scroll through the entries with your finger on the touchscreen.

Remote command:
LAY:ADD? '1',RIGH, PEAK, see LAYout:ADD[:WINDow]? on page 121
Results:
CALCulate<n>:MARKer<m>:X on page 157
CALCulate<n>:MARKer<m>:Y on page 158

3.7 3GPP test scenarios

3GPP defines several test scenarios for measuring user equipment. These test scenarios are described in detail in 3GPP TS 36.521-1.

The following table provides an overview which measurements available in the LTE application are suited to use for the test scenarios in the 3GPP documents.

Table 3-4: Test scenarios for E-TMs as defined by 3GPP (3GPP TS 36.521-1)

Test scenario	Test described in	Measurement
UE maximum output power	chapter 6.2.2	Power (→ "Result Summary")
Maximum power reduction	chapter 6.2.3	Power (→ "Result Summary")
Additional maximum power reduction	chapter 6.2.4	Power (→ "Result Summary")
Configured UE-transmitted output power	chapter 6.2.5	Power (→ "Result Summary")
Minimum output power	chapter 6.3.2	Power (→ "Result Summary")
Transmit off power	chapter 6.3.3	n/a
On/off time mask	chapter 6.3.4	n/a
Power control	chapter 6.3.5	n/a
Frequency error	chapter 6.5.1	Frequency error (→ "Result Summary")

Test scenario	Test described in	Measurement
Transmit modulation	chapter 6.5.2.1	EVM results
	chapter 6.5.2.2	I/Q offset (→ "Result Summary")
	chapter 6.5.2.3	Inband emission
	chapter 6.5.2.4	Spectrum flatness
Occupied bandwidth	chapter 6.6.1	Occupied bandwidth[1]
Out of band emission	chapter 6.6.2.1	Spectrum emission mask
	chapter 6.6.2.2	Spectrum emission mask
	chapter 6.6.2.3	ACLR
Spurious emissions	chapter 6.6.3.1	Spurious emissions[1]
	chapter 6.6.3.2	Spurious emissions[1]
	chapter 6.6.3.3	Spurious emissions[1]
Transmit intermodulation	chapter 6.7	ACLR
Time alignment	chapter 6.8	Time alignment

[1]these measurements are available in the spectrum application of the Rohde & Schwarz signal and spectrum analyzers (for example the R&S FSW)

4 Measurement basics

4.1 Symbols and variables

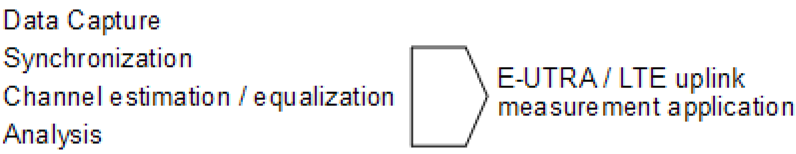
The following chapters use various symbols and variables in the equations that the measurements are based on. The table below explains these symbols for a better understanding of the measurement principles.

$a_{l,k} \hat{a}_{l,k}$	data symbol (actual, decided)
$A_{l,k}$	data symbol after DFT-precoding
Δf, $\Delta \hat{f}_{coarse}$	carrier frequency offset between transmitter and receiver (actual, coarse estimate)
Δf_{res}	residual carrier frequency offset
ζ	relative sampling frequency offset
$H_{l,k}$, $\hat{H}_{l,k}$	channel transfer function (actual, estimate)
i	time index
$\hat{i}_{coarse}$, $\hat{i}_{fine}$	timing estimate (coarse, fine)
k	subcarrier index
l	SC-FDMA symbol index
N_{DS}	number of SC-FDMA data symbols
N_{FFT}	length of FFT
N_g	number of samples in cyclic prefix (guard interval)
N_s	number of Nyquist samples
N_{TX}	number of allocated subcarriers
$N_{k,l}$	noise sample
n	index of modulated QAM symbol before DFT pre-coding
Φ_l	common phase error
r_i	received sample in the time domain
$R'_{k,l}$	uncompensated received sample in the frequency domain

$r_{n,l}$	equalized received symbols of measurement path after IDFT
T	duration of the useful part of an SC-FDMA symbol
T_g	duration of the guard interval
T_s	total duration of SC-FDMA symbol

4.2 Overview

The digital signal processing (DSP) involves several stages until the software can present results like the EVM.



The contents of this chapter are structured like the DSP.

4.3 The LTE uplink analysis measurement application

The block diagram in Figure 4-1 shows the general structure of the LTE uplink measurement application from the capture buffer containing the I/Q data up to the actual analysis block.

After synchronization a fully compensated signal is produced in the reference path (purple) which is subsequently passed to the equalizer. An IDFT of the equalized symbols yields observations for the QAM transmit symbols $a_{n,l}$ from which the data estimates $\hat{a}_{n,l}$ are obtained via hard decision. Likewise a user defined compensation as well as equalization is carried out in the measurement path (cyan) and after an IDFT the observations of the QAM transmit symbols are provided. Accordingly, the measurement path might still contain impairments which are compensated in the reference path. The symbols of both signal processing paths form the basis for the analysis.

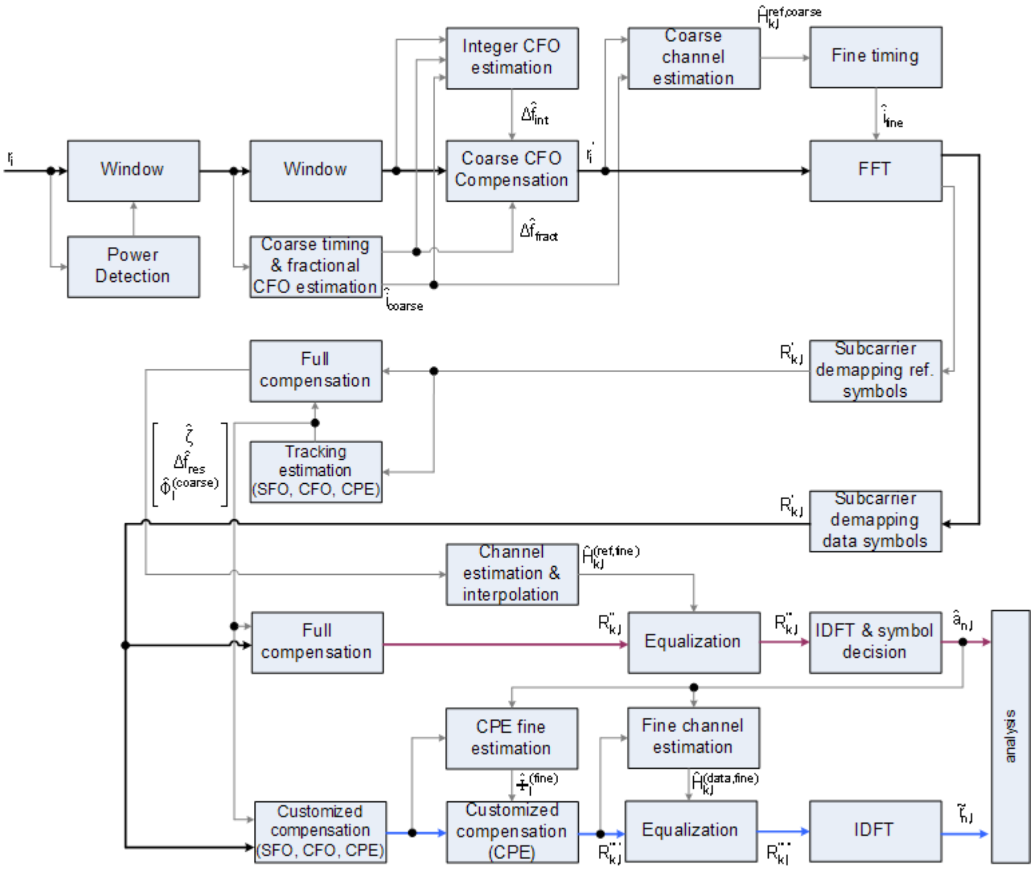


Figure 4-1: Block diagram for the LTE UL measurement application

4.3.1 Synchronization

In a first step the areas of sufficient power are identified within the captured I/Q data stream which consists of the receive samples r_i. For each area of sufficient power, the analyzer synchronizes on subframes of the uplink generic frame structure [3]. After this coarse timing estimation, the fractional part as well as the integer part of the carrier frequency offset (CFO) are estimated and compensated. In order to obtain an OFDM demodulation via FFT of length N_{FFT} that is not corrupted by ISI, a fine timing is established which refines the coarse timing estimate.

A phase tracking based on the reference SC-FDMA symbols is performed in the frequency domain. The corresponding tracking estimation block provides estimates for

- the relative sampling frequency offset ζ
- the residual carrier frequency offset Δf_{res}
- the common phase error Φ_l

According to references [7] and [8], the uncompensated samples $R'_{k,l}$ in the DFT-precoded domain can be stated as

$$R'_{k,l} = A_{k,l} \cdot H_{k,l} \cdot \underbrace{e^{j\Phi_l}}_{CPE} \cdot \underbrace{e^{j2\pi \cdot N_S / N_{FFT} \cdot \zeta \cdot k \cdot l}}_{SFO} \cdot \underbrace{e^{j2\pi \cdot N_S / N_{FFT} \cdot \Delta f_{res} \cdot T \cdot l}}_{res.CFO} + N_{k,l}$$

Equation 4-1:

with

- the DFT precoded data symbol $A_{k,l}$ on subcarrier k at SC-FDMA symbol l,
- the channel transfer function $H_{k,l}$,
- the number of Nyquist samples N_S within the total duration T_S,
- the duration of the useful part of the SC-FDMA symbol $T=T_S-T_g$
- the independent and Gaussian distributed noise sample $N_{k,l}$

Within one SC-FDMA symbol, both the CPE and the residual CFO cause the same phase rotation for each subcarrier, while the rotation due to the SFO depends linearly on the subcarrier index. A linear phase increase in symbol direction can be observed for the residual CFO as well as for the SFO.

The results of the tracking estimation block are used to compensate the samples $R'_{k,l}$ completely in the reference path and according to the user settings in the measurement path. Thus the signal impairments that are of interest to the user are left uncompensated in the measurement path.

After having decoded the data symbols in the reference path, an additional data-aided phase tracking can be utilized to refine the common phase error estimation.

4.3.2 Analysis

The analysis block of the EUTRA/LTE uplink measurement application allows to compute a variety of measurement variables.

EVM

The most important variable is the error vector magnitude which is defined as

$$EVM_{l,k} = \frac{\left|\tilde{r}_{n,l} - \hat{a}_{n,l}\right|}{\sqrt{E\left\{\left|a_{n,l}\right|^2\right\}}}$$

Equation 4-2:

for QAM symbol n before precoding and SC-FDMA symbol l. Since the normalized average power of all possible constellations is 1, the equation can be simplified to

$$EVM_{n,l} = \left|\tilde{r}_{n,l} - \hat{a}_{n,l}\right|$$

Equation 4-3:

The average EVM of all data subcarriers is then

$$EVM_{data} = \sqrt{\frac{1}{N_{DS}N_{TX}} \sum_{l=0}^{N_{LB}-1} \sum_{n=0}^{N_{TX}-1} EVM_{n,l}^2}$$

Equation 4-4:

for N_{DS} SC-FDMA data symbols and the N_{TX} allocated subcarriers.

I/Q imbalance

The I/Q imbalance contained in the continuous received signal r(t) can be written as

$$r(t) = I\,\Re\{s(t)\} + jQ\,\Im\{s(t)\}$$

Equation 4-5:

where s(t) is the transmit signal and I and Q are the weighting factors describing the I/Q imbalance. We define that I:=1 and Q:=1+ΔQ.

The I/Q imbalance estimation makes it possible to evaluate the

$$\text{modulator gain balance} = |1 + \Delta Q|$$

Equation 4-6:

and the

$$\text{quadrature mismatch} = \arg\{1 + \Delta Q\}$$

Equation 4-7:

based on the complex-valued estimate $\Delta\hat{Q}$.

Basic in-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

The relative in-band emissions are given by

$$Emissions_{relative}(\Delta_{RB}) = \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_S| \cdot N_{RB}} \sum_{t \in T_S} \sum_{c}^{c+12 \cdot N_{RB}-1} |Y(t,f)|^2}$$

Equation 4-8:

where T_S is a set $|T_S|$ of SC-FDMA symbols with the considered modulation scheme being active within the measurement period, Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB}=1 or Δ_{RB}=-1 for the first adjacent RB), c is the lower edge of the allocated BW, and Y(t,f) is the frequency domain signal evaluated for in-band emissions. N_{RB} is the number of allocated RBs .

The basic in-band emissions measurement interval is defined over one slot in the time domain.

Other measurement variables

Without going into detail, the EUTRA/LTE uplink measurement application additionally provides the following results:

- Total power
- Constellation diagram
- Group delay
- I/Q offset
- Crest factor
- Spectral flatness

4.4 Performing time alignment measurements

The measurement application allows you to perform time alignment measurements between different antennas.

The measurement supports setups of up to two Tx antennas.

The result of the measurement is the time alignment error. The time alignment error is the time offset between a reference antenna (for example antenna 1) and another antenna.

The time alignment error results are summarized in the corresponding result display.

A schematic description of the results is provided in Figure 4-2.

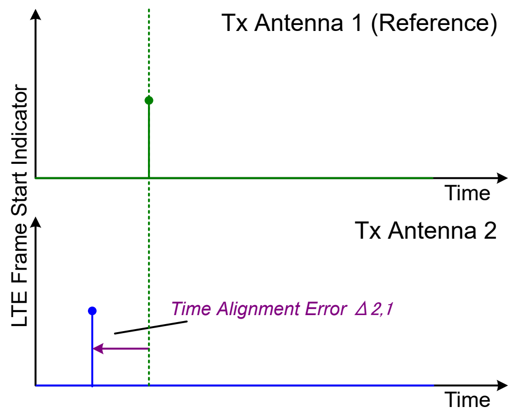


Figure 4-2: Time Alignment Error (2 Tx antennas)

Test setup

Successful Time Alignment measurements require a correct test setup.

A typical test setup is shown in Figure 4-3.

Figure 4-3: Hardware setup

For best measurement result accuracy, it is recommended to use cables of the same length and identical combiners as adders.

In the application, make sure to correctly apply the following settings.

- Select a reference antenna in the MIMO Configuration dialog box (**not** "All")
- Select more than one antenna in the MIMO Configuration dialog box
- Select Codeword-to-Layer mapping "2/1" or "2/2"
- Select an Auto Demodulation different to "Subframe Configuration & DMRS"
- The transmit signals of all available Tx antennas have to be added together

4.5 SRS EVM calculation

In order to calculate an accurate EVM, a channel estimation needs to be done prior to the EVM calculation. However, the channel estimation requires a minimum of two resource elements containing reference symbols on a subcarrier. Depending on the current Channel Estimation Range setting, this means that either at least two reference symbols ("Pilot Only") or one reference symbol and at least one data symbol ("Pilot and Payload") need to be available on the subcarrier the EVM is to be measured.

For PUSCH, PUCCH and PRACH regions, these conditions are normally fulfilled because the DMRS (= Demodulation Reference Signal) is already included. However, the SRS may also be located on subcarriers which do not occupy any other reference symbols (see Figure 4-4).

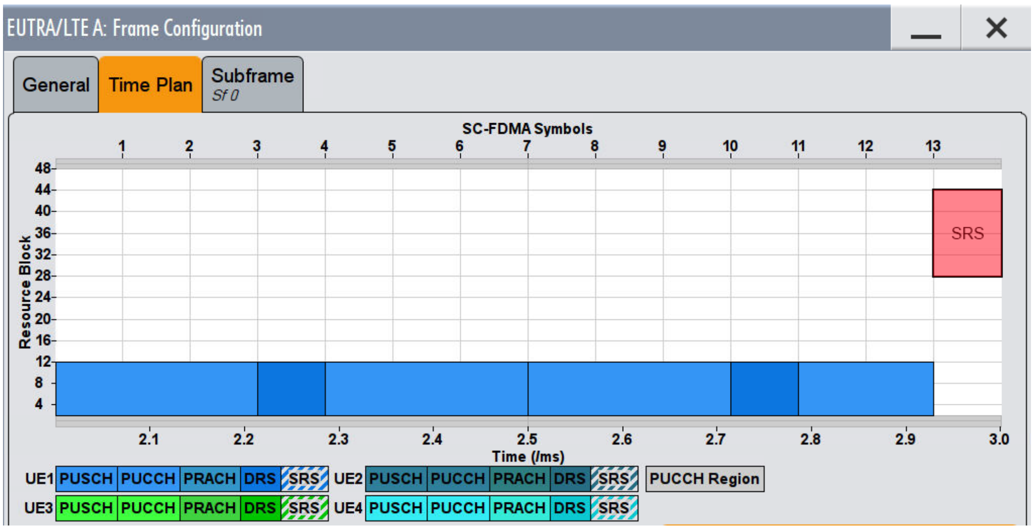


Figure 4-4: No EVM can be measured for the SRS

In this case it is not reasonable to calculate an EVM and no SRS EVM value will be displayed for the corresponding subframe.

If the SRS subcarriers contain two DMRS symbols (or one DMRS and one PUSCH for "Pilot and Payload" channel estimation range) the SRS EVM can be measured (see Figure 4-5).

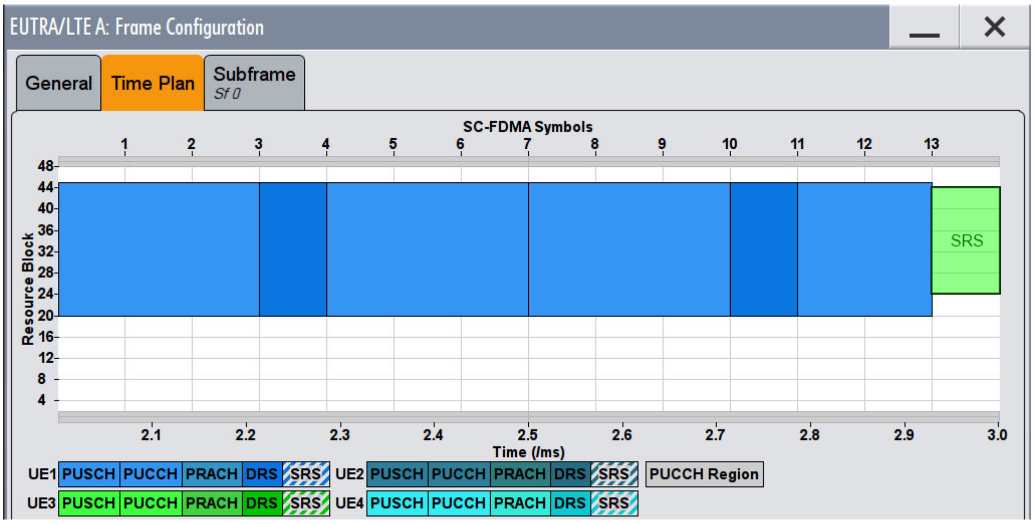


Figure 4-5: The EVM of the complete SRS can be measured

The SRS allocation might cover subcarriers which partly fulfill the conditions mentioned above and partly do not. In this case the EVM value given in the Allocation Summary will be calculated based only on the subcarriers which fulfill the above requirements (see Figure 4-6).

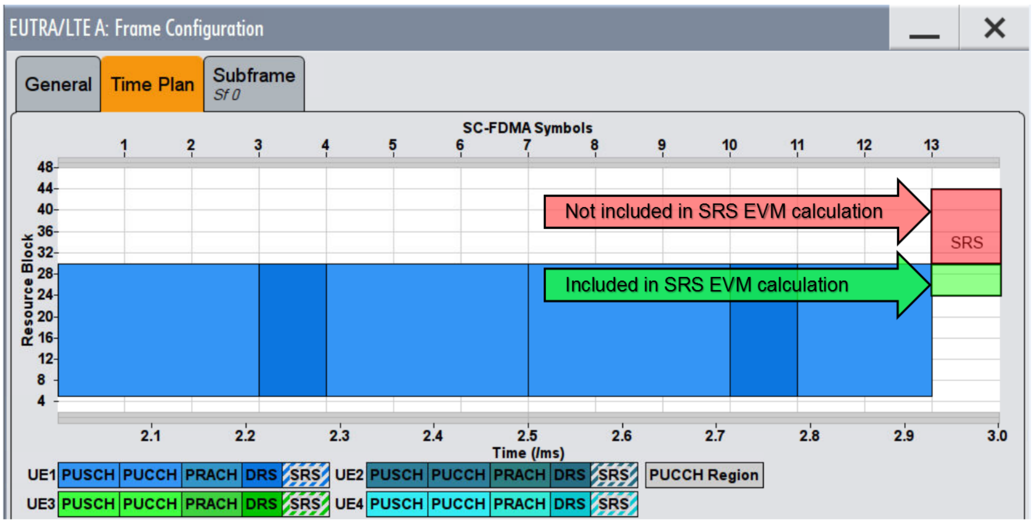


Figure 4-6: The EVM for parts of the SRS can be measured

4.6 O-RAN measurement guide

The O-RAN alliance specifies specific signal configurations (test cases) for standardized testing of O-RAN equipment. The R&S FSV/A provides these O-RAN test cases. When you apply one of them, the measurement configuration automatically adjusts to the values of the selected test case.

Basically, you can verify O-RAN based signals by certain bit sequences in the PUSCH and the positions of those sequences. The position of the bit sequence in the PUSCH is unique for each test case.

As pointed out, these settings are automatically selected, depending on the selected test case.

For valid measurement results, it is essential that the measured signal complies with the selected test case and uses the correct bit sequences in the correct locations. If you get unexpected measurement results, check if the signal is configured correctly. You can do a quick check to validate the signal as follows.

- Check if the selected test case in the "Advanced Settings" is the same as the test case in the "Test Models" dialog.
- Use the Bitstream result display to verify if the bits match the O-RAN specifications. Each test case has a typical bit sequence. Make sure to select the bit sequence as the bitstream format.

5 Configuration

LTE measurements require a special application on the R&S FSV/A, which you activate using the [MODE] key on the front panel.

When you start the LTE application, the R&S FSV/A starts to measure the input signal with the default configuration or the configuration of the last measurement (when you haven't performed a preset since then). After you have started an instance of the LTE application, the application displays the "Meas Config" menu which contains functions to define the characteristics of the signal you are measuring.

Automatic refresh of preview and visualization in dialog boxes after configuration changes

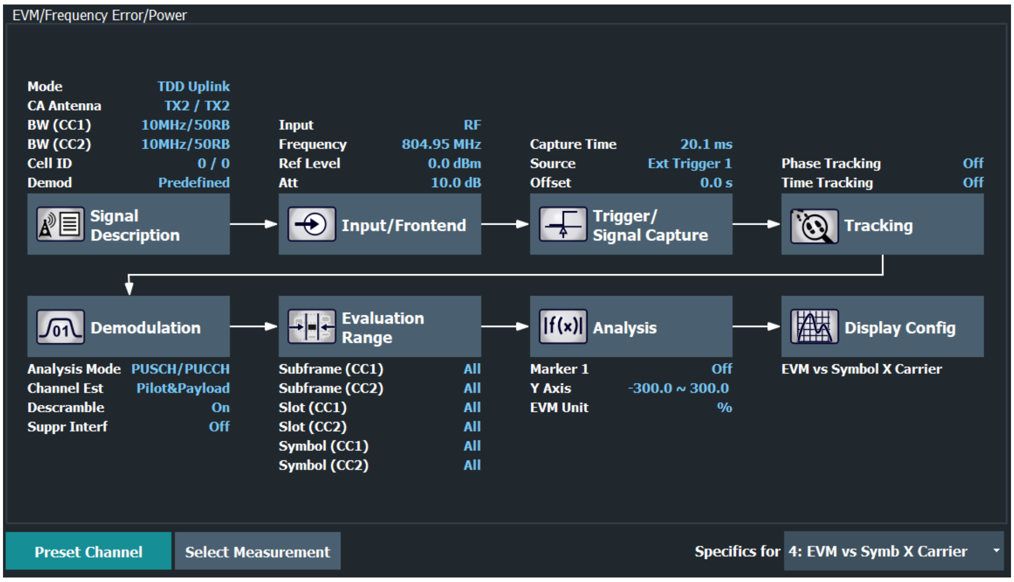
The R&S FSV/A supports you in finding the correct measurement settings quickly and easily - after each change in settings in dialog boxes, the preview and visualization areas are updated immediately and automatically to reflect the changes. Thus, you can see if the setting is appropriate or not before accepting the changes.

Unavailable hardkeys

Note that the [SPAN], [BW], [TRACE], [LINES] and [MKR FUNC] keys have no contents and no function in the LTE application.

5.1 Configuration overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" icon, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Signal Description
   See Chapter 5.2.1, "Signal characteristics", on page 52.
2. Input / Frontend
   See Chapter 5.2.11, "Input source configuration", on page 80.
3. Trigger / Signal Capture
   See Chapter 5.2.15, "Trigger configuration", on page 89.
   See Chapter 5.2.14, "Data capture", on page 87
4. Tracking
   See Chapter 5.2.16, "Tracking configuration", on page 91.
5. Demodulation
   see Chapter 5.2.17, "Signal demodulation", on page 92.
6. Evaluation Range
   See Chapter 6.2.2, "Evaluation range", on page 103.
7. Analysis
   See Chapter 6, "Analysis", on page 99.
8. Display Configuration
   See Chapter 3, "Measurements and result displays", on page 13.

In addition, the dialog box provides the "Select Measurement" button that serves as a shortcut to select the measurement type.

Note that the "Overview" dialog box for frequency sweep measurement is similar to that of the Spectrum mode.

For more information refer to the documentation of the R&S FSV/A.

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

Preset Channel
Select "Preset Channel" in the lower left-hand corner of the "Overview" to restore all measurement settings *in the current channel* to their default values.

Note: Do not confuse "Preset Channel" with the [Preset] *key*, which restores the entire instrument to its default values and thus closes *all channels* on the R&S FSV/A (except for the default channel)!

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 179

Select Measurement
Opens a dialog box to select the type of measurement.

For more information about selecting measurements, see Chapter 3.1, "Selecting measurements", on page 13.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 178

Specific Settings for
The channel can contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

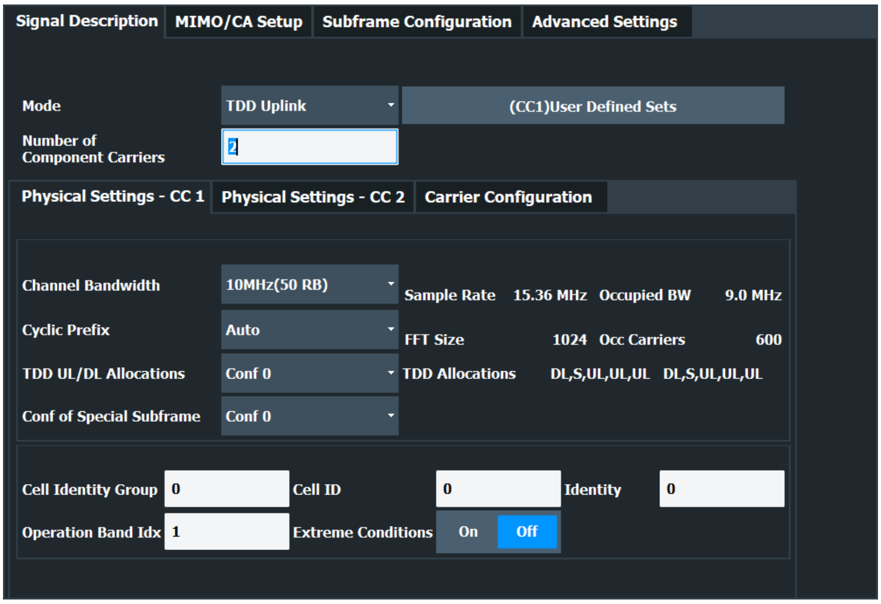
The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

5.2 I/Q measurements

5.2.1 Signal characteristics

Access: "Overview" > "Signal Description" > "Signal Description"

The general signal characteristics contain settings to describe the general physical attributes of the signal.



Selecting the LTE mode

The "Mode" selects the LTE standard you are testing.

The choices you have depend on the set of options you have installed.

- Option xxx-K100 enables testing of 3GPP LTE FDD signals on the downlink
- Option xxx-K101 enables testing of 3GPP LTE FDD signals on the uplink
- Option xxx-K102 enables testing of 3GPP LTE MIMO signals on the downlink
- Option xxx-K103 enables testing of 3GPP MIMO signals on the uplink
- Option xxx-K104 enables testing of 3GPP LTE TDD signals on the downlink
- Option xxx-K105 enables testing of 3GPP LTE TDD signals on the uplink
- Option xxx-K106 enables testing of 3GPP LTE NB-IoT TDD signals on the down-link

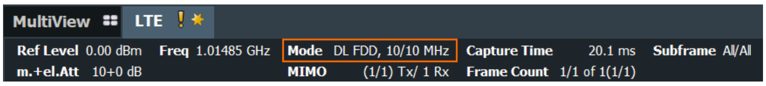
FDD and TDD are **duplexing** methods.

- FDD mode uses different frequencies for the uplink and the downlink.
- TDD mode uses the same frequency for the uplink and the downlink.

Downlink (DL) and Uplink (UL) describe the **transmission path**.

- Downlink is the transmission path from the base station to the user equipment. The physical layer mode for the downlink is always OFDMA.
- Uplink is the transmission path from the user equipment to the base station. The physical layer mode for the uplink is always SC-FDMA.

The application shows the currently selected LTE mode (including the bandwidth) in the channel bar.



Remote command:
Link direction: `CONFigure[:LTE]:LDIRection` on page 181
Duplexing mode: `CONFigure[:LTE]:DUPLexing` on page 181

Carrier Aggregation

Carrier aggregation has been introduced in the LTE standard to increase the band-width. In those systems, several carriers can be used to transmit a signal.

Each carrier usually has one of the channel bandwidths defined by 3GPP.

The R&S FSV/A features several measurements that support contiguous and non-con-tiguous intra-band carrier aggregation (the carriers are in the same frequency band).

- I/Q based measurements (EVM, frequency error, etc.) (downlink)
- I/Q based measurements (EVM, frequency error, etc.) (uplink)
- Time alignment error (downlink)
- Time alignment error (uplink)
- Cumulative ACLR (downlink, non-contiguous intra-band carrier aggregation)
- Multi carrier ACLR (downlink, non-contiguous intra-band carrier aggregation)
- Multi carrier ACLR (uplink, contiguous intra-band carrier aggregation)
- SEM (downlink, non-contiguous intra-band carrier aggregation)
- SEM (uplink, contiguous intra-band carrier aggregation)

The way to configure these measurements is similar (but not identical, the differences are indicated below).

- "Basic component carrier configuration" on page 54
- "Features of the I/Q measurements" on page 54
- "Features of the time alignment error measurement" on page 55
- "Features of the MC ACLR measurement" on page 56
- "Remote commands to configure carrier aggregation" on page 56

Basic component carrier configuration ← Carrier Aggregation

The number of component carriers (CCs) you can select depends on the measurement.

- I/Q based measurements (EVM etc.): up to 5 CCs
- Time alignment error: up to 2 CCs
- Multi-carrier ACLR: 2 CCs (fix value)
- SEM: up to 2 CCs

- The "Center Frequency" defines the carrier frequency of the carriers.
- For each carrier, you can select the "Bandwidth" from the corresponding dropdown menu.
- For all component carriers, the R&S FSV/A also shows the "Frequency Offset" relative to the center frequency of the first carrier.

Note that the application automatically calculates the frequency and offset of the second (or subsequent) carrier according to the specification.

Note that the actual measurement frequency differs from the carrier frequencies: the application calculates that frequency based on the carrier frequencies. It is somewhere in between the carrier frequencies.

The measurement frequency is displayed in the channel bar.

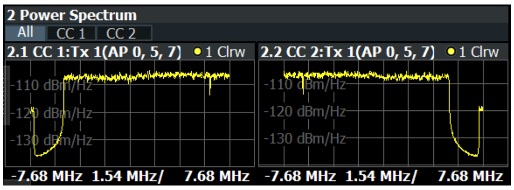
Selecting the **channel bandwidths** of each carrier is possible in two ways.

- Predefined bandwidth combinations
  Select a typical combination of channel bandwidths from the dropdown menu.
  This way, you just have to define the center frequency of the first carrier. The application calculates the rest of the frequency characteristics.
- User Defined
  Select "User Defined" from the dropdown menu to test a system with channel bandwidths not in the list of predefined combinations.
  When you select a user-defined combination, you can select the channel bandwidth for each carrier from the "Bandwidth" dropdown menus.

When the defined carrier configuration is not supported by the application, a corresponding error message is displayed. This can be the case, for example, if the carriers occupy a bandwidth that is too large.

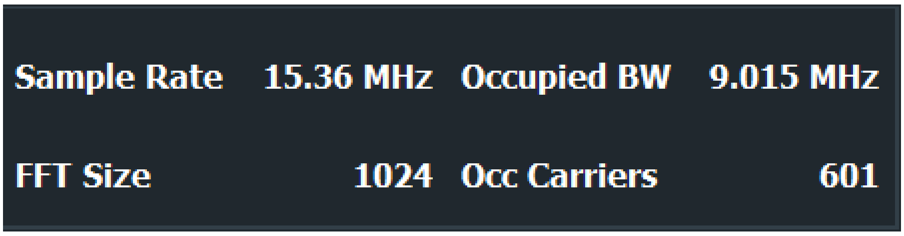
Features of the I/Q measurements ← Carrier Aggregation

For measurements on component carriers, results are shown for each component carrier separately. The layout of the diagrams is adjusted like this:



- The first tab ("All") shows the results for all component carriers.
- The other tabs ("CC <x>") show the results for each component carrier individually.

The application also shows the "Occupied Bandwidth" of the aggregated carriers and the "Sample Rate" in a read-only field below the carrier configuration.



The application also allows you to select the location of the local oscillator (LO) in your system. You can thus define if your system uses one LO (for both carriers) or two LOs (one for each carrier). This can be useful if you want to reliably exclude the DC component from the measurement results in both scenarios.

The application supports the following "LO locations".

- **Center of each component carrier**
  One LO for each carrier that is located at the center frequency of the component carrier. See Basic component carrier configuration for information about how center frequencies are defined.
- **Center of aggregated channel bandwidth**
  One LO for both carriers that is located at the center of the aggregated carriers.
- **User defined**
  One LO for both carriers that is not necessarily located at the center of the aggregated carriers.
  When you select this option, the application opens an input field to define the real "LO Frequency", which you arbitrarily define.

Features of the time alignment error measurement ← Carrier Aggregation

Note that the TAE measurements are possible on one R&S FSV/A only. Therefore the number of devices to measure is always "1".

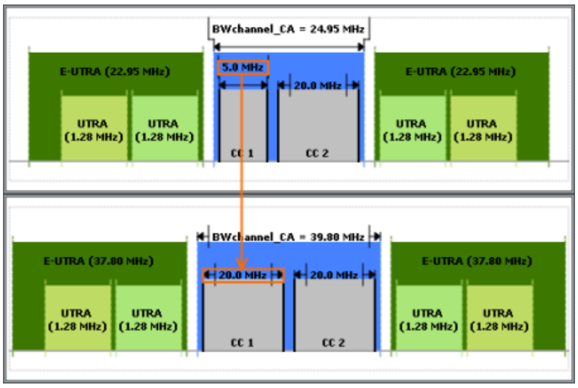
You can configure additional signal characteristics of the first and second carrier in the "CC1" and "CC2" tabs.

In case you are testing a MIMO DUT, you can also select the number of antennas the DUT supports. When you select "1 Tx Antenna", the application measures the timing difference between two SISO carriers, when you select more than one antenna, it measures the timing difference between the antennas. In that case, you can select the reference antenna from the dropdown menu in the time alignment error result display.

Note that the application shows measurement results for the second component carrier even if only one antenna of the second component carrier is attached (i.e. no combiner is used).

Features of the MC ACLR measurement ← Carrier Aggregation
The diagram at the bottom of the dialog box represents the current configuration. When you change the bandwidth of a carrier (represented by blue bars), the application adjusts the bandwidth of the carriers in the diagram accordingly.

The characteristics of the neighboring channels in the MC ACLR measurement are defined in 3GPP 36.251 (represented by green bars).



Remote commands to configure carrier aggregation ← Carrier Aggregation

Remote command:
Number of carriers: `CONFigure[:LTE]:NOCC` on page 229
Carrier frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 211
Measurement frequency: `SENSe:FREQuency:CENTer?`
Offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 212
Channel bandwidth: `CONFigure[:LTE]:UL:CABW` on page 230
Channel bandwidth: `CONFigure[:LTE]:UL[:CC<cc>]:BW` on page 181
Number of devices: `CONFigure[:LTE]:NDEVices` on page 230
LO location: `[SENSe:][LTE:]UL:DEMod:LOLocation` on page 187
LO frequency: `[SENSe:][LTE:]UL:DEMod:LOFRequency` on page 186

Channel Bandwidth / Number of Resource Blocks
Specifies the channel bandwidth and number of resource blocks (RB).

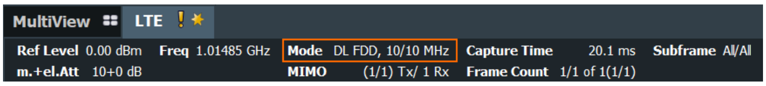
The channel bandwidth and number of resource blocks (RB) are interdependent. Currently, the LTE standard recommends six bandwidths (see table below).

The application also calculates the FFT size, sampling rate, occupied bandwidth and occupied carriers from the channel bandwidth. Those are read only.

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Number of Resource Blocks	6	15	25	50	75	100
Sample Rate [MHz]	1.92	3.84	7.68	15.36	30.72	30.72
FFT Size	128	256	512	1024	2048	2048

For more information about configuring aggregated carriers, see "Carrier Aggregation" on page 53.

The application shows the currently selected LTE mode (including the bandwidth) in the channel bar.



Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:BW` on page 181

Cyclic Prefix

The cyclic prefix serves as a guard interval between OFDM symbols to avoid interferences. The standard specifies two cyclic prefix modes with a different length each.

The cyclic prefix mode defines the number of OFDM symbols in a slot.

- Normal
  A slot contains 7 OFDM symbols.
- Extended
  A slot contains 6 OFDM symbols.
  The extended cyclic prefix is able to cover larger cell sizes with higher delay spread of the radio channel.
- Auto
  The application automatically detects the cyclic prefix mode in use.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:CYCPrefix` on page 182

Configuring TDD Frames

TDD frames contain both uplink and downlink information separated in time with every subframe being responsible for either uplink or downlink transmission. The standard specifies several subframe configurations or resource allocations for TDD systems.

TDD UL/DL Allocations ← Configuring TDD Frames

Selects the configuration of the subframes in a radio frame in TDD systems.

The UL/DL configuration (or allocation) defines the way each subframe is used: for uplink, downlink or if it is a special subframe. The standard specifies seven different configurations.

Configuration	Subframe Number and Usage									
	0	1	2	3	4	5	6	7	8	9
0	D	S	U	U	U	D	S	U	U	U
1	D	S	U	U	D	D	S	U	U	D
2	D	S	U	D	D	D	S	U	D	D
3	D	S	U	U	U	D	D	D	D	D
4	D	S	U	U	D	D	D	D	D	D
5	D	S	U	D	D	D	D	D	D	D
6	D	S	U	U	U	D	S	U	U	D

U = uplink
D = downlink
S = special subframe

Remote command:
Subframe: `CONFigure[:LTE]:UL[:CC<cc>]:TDD:UDConf` on page 183

Conf. of Special Subframe ← Configuring TDD Frames
In combination with the cyclic prefix, the special subframes serve as guard periods for switches from uplink to downlink. They contain three parts or fields.

- DwPTS
  The DwPTS is the downlink part of the special subframe. It is used to transmit downlink data.
- GP
  The guard period makes sure that there are no overlaps of up- and downlink signals during a switch.
- UpPTS
  The UpPTS is the uplink part of the special subframe. It is used to transmit uplink data.

The length of the three fields is variable. This results in several possible configurations of the special subframe. The LTE standard defines 10 different configurations for the special subframe. However, configurations 8 and 9 only work for a normal cyclic prefix.

If you select configurations 8 or 9 using an extended cyclic prefix or automatic detection of the cyclic prefix, the application will show an error message.

Remote command:
Special subframe: `CONFigure[:LTE]:UL[:CC<cc>]:TDD:SPSC` on page 183

Configuring the Physical Layer Cell Identity
The "Cell ID", "Cell Identity Group" and physical layer "Identity" are interdependent parameters. In combination, they are responsible for synchronization between network and user equipment.

The physical layer cell ID identifies a particular radio cell in the LTE network. The cell identities are divided into 168 unique cell identity groups. Each group consists of 3 physical layer identities. According to:

$$N_{ID}^{cell} = 3 \cdot N_{ID}^{(1)} + N_{ID}^{(2)}$$

$N^{(1)}$ = cell identity group, {0...167}
$N^{(2)}$ = physical layer identity, {0...2}

there is a total of 504 different cell IDs.

If you change one of these three parameters, the application automatically updates the other two.

The cell ID determines:

- The reference signal grouping hopping pattern
- The reference signal sequence hopping
- The PUSCH demodulation reference signal pseudo-random sequence
- The cyclic shifts for PUCCH formats 1/1a/1b and sequences for PUCCH formats 2/2a/2b

- The pseudo-random sequence used for scrambling
- The pseudo-random sequence used for type 2 PUSCH frequency hopping

It is possible to select a separate "Identity" for Demodulation Reference Signal, PUSCH and PUCCH allocations from the "Identity" property in the "Advanced Signal Characteristics". When you select "From Cell ID", the "Identity" for the DMRS, PUSCH and PUCCH is the same as the Cell ID.

Remote command:
Cell ID: `CONFigure[:LTE]:UL[:CC<cc>]:PLC:CID` on page 182
Cell Identity Group: `CONFigure[:LTE]:UL[:CC<cc>]:PLC:CIDGroup` on page 182
Identity: `CONFigure[:LTE]:UL[:CC<cc>]:PLC:PLID` on page 183
Identity (DRS): `CONFigure[:LTE]:UL[:CC<cc>]:DRS:PLID` on page 195
Identity (PUCCH): `CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:PLID` on page 205
Identity (PUSCH): `CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:PLID` on page 202

Operating Band Index
Selects one of the 40 operating bands for spectrum flatness measurements as defined in TS 36.101.

The operating band defines the frequency band and the dedicated duplex mode.

Remote command:
`[SENSe:][LTE:][CC<cc>:]SFLatness:OBANd` on page 186

Extreme Conditions
Turns extreme conditions on and off.

If you turn the extreme conditions on, the R&S FSV/A adjusts the limits for the limit check of the spectrum flatness evaluation.

Remote command:
`[SENSe:][LTE:][CC<cc>:]SFLatness:ECONditions` on page 186

5.2.2 Test scenarios

Access: "Overview" > "Signal Description" > "Test Models"

Test scenarios are descriptions of specific LTE signals for standardized testing of DUTs. These test scenarios are stored in `.allocation` files. You can select, manage and create test scenarios in the "Test Models" dialog box.

ORAN test cases
O-RAN test cases are available for FDD signals.

In addition to the 3GPP test models, you can also use O-RAN test cases. O-RAN test cases are defined by the O-RAN alliance for standardized measurements.

The test cases comply with O-RAN specification O-RAN.WG4.CONF.0-v08.00.

The O-RAN test cases are based on the 3GPP test models (downlink) and fixed reference channels (uplink) and are customized for the O-RAN applications.

For more information about the test cases themselves, see the O-RAN specifications available on the O-RAN website.

For more information about using O-RAN test cases in measurements with the R&S FSV/A, see Chapter 4.6, "O-RAN measurement guide", on page 48.

Remote command:
MMEMory:LOAD[:CC<cc>]:TMOD:UL on page 185

User defined test scenarios
User defined test scenarios are custom signal descriptions for standardized measurements that you can save and restore as you like. To create a custom test scenario, describe a signal as required and then save it with the corresponding button. The R&S FSV/A stores custom scenarios in .allocation files.

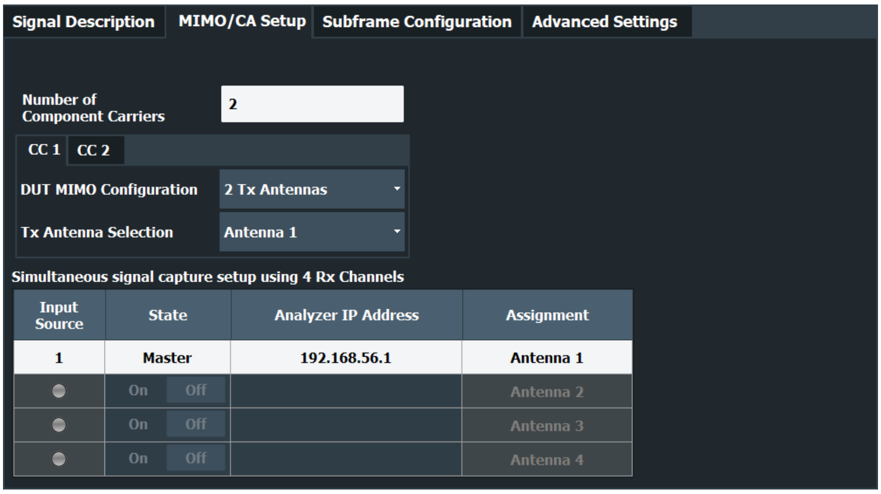
If you do not need test scenarios any longer, you can also delete them.

Remote command:
Save: MMEMory:STORe<n>[:CC<cc>]:DEModsetting on page 185
Restore: MMEMory:LOAD[:CC<cc>]:DEModsetting on page 185

5.2.3 MIMO configuration

Access: "Overview" > "Signal Description" > "MIMO / CA Setup"

The MIMO Configuration contains settings to configure MIMO test setups.



Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

MIMO Configuration
Selects the antenna configuration and test conditions for a MIMO system.

The MIMO **configuration** selects the number of transmit antennas for selected channels in the system.

In setups with multiple antennas, the **antenna selection** defines the antenna you'd like to test. Note that as soon as you have selected a transmission on more than one antenna for one of the channels, the corresponding number of antennas becomes available for testing.

Antenna 1	Tests antenna 1 only.
Antenna 2	Tests antenna 2 only.
Antenna 3	Tests antenna 3 only.
Antenna 4	Tests antenna 4 only.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:MIMO:ASELection` on page 187

Input Source Configuration Table
not supported

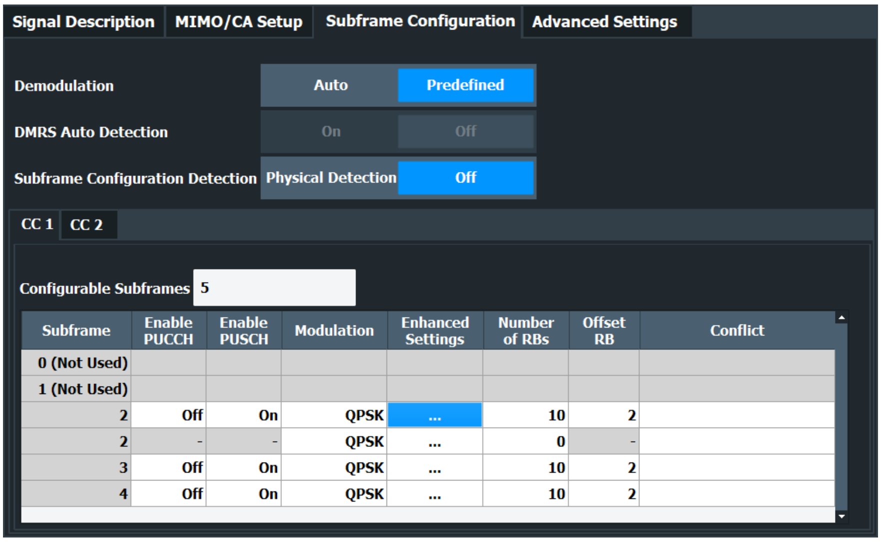
5.2.4 Subframe configuration

Access: "Overview" > "Signal Description" > "Subframe Configuration"

An LTE frame consists of 10 subframes. Each individual subframe can have a different resource block configuration. This configuration is shown in the "Subframe Configuration Table".

The application supports two ways to determine the characteristics of each subframe.

- Automatic demodulation of the channel configuration and detection of the subframe characteristics.
  For automatic demodulation, the contents of the table are determined according to the signal currently evaluated.
  For more information, see "Auto Demodulation" on page 62.
- Custom configuration of the configuration of each subframe.
  For manual configuration, you can customize the table according to the signal that you expect. The signal is demodulated even if the signal does not fit the description in the table or, for Physical Detection, only if the frame fits the description in the table.
  Remote command:
  Conf. subframes: `CONFigure[:LTE]:UL[:CC<cc>]:CSUBframes` on page 188



Frame number offset

A frame number offset is also supported. The frame number offset assigns a number to the demodulated frame in order to identify it in a series of transmitted (and captured) frames. You can define this frame in the Global Settings.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:SFNO` on page 193

5.2.4.1 General subframe configuration

Auto Demodulation

Turns automatic demodulation on and off.

When you select "Predefined" mode, you can configure the subframe manually.

When you select "Auto" mode, the R&S FSV/A automatically detects the characteristics of each subframe in the signal (resource allocation of the signal). Two methods of detection are supported:

- Auto Demodulation, **DMRS Auto Detection (Off)**
  This method automatically determines the characteristics for each subframe as shown in the Subframe Configuration Table.
  The table is populated accordingly.
- Subframe Configuration & DMRS
  Auto Demodulation, **DMRS Auto Detection (On)**
  This method automatically detects the PUSCH and SRS (i.e. no PUCCH can be detected).

To determine these characteristics, the software detects the CAZAC base parameters. Thus, the DMRS configuration parameters are not required for the synchronization and therefore are not available using this method.
Note however that it is not possible to derive the DMRS configuration parameters from the CAZAC base parameters so that the disabled DMRS configuration parameters do not reflect the current parameters used for the synchronization. Also note that it can happen that the software successfully synchronizes on non-3GPP signals without a warning.

Automatic demodulation is not available if you suppress interferers for synchronization is active.

Remote command:
`[SENSe:][LTE:]UL:DEMod:ACON` on page 193

Subframe Configuration Detection

Turns the detection of the subframe configuration on and off.

When you select "Physical Detection", the R&S FSV/A compares the currently demodulated LTE frame to the subframe configuration you have defined in the table. The application only analyzes the LTE frame if the signal is consistent with the configuration.

When you turn the feature "Off", the software analyzes the signal even if it is not consistent with the current subframe configuration.

Subframe configuration detection is available if you are using a Predefined subframe configuration.

Remote command:
`[SENSe:][LTE:]UL:FORMat:SCD` on page 193

5.2.4.2 Individual subframe configuration

The "Subframe Configuration Table" contains the characteristics for each subframe. The software supports a maximum uplink LTE frame size of 10 subframes. The subframe number in the table depends on the number of "Configurable Subframes" that you have defined or that have been detected for automatic demodulation.

Subframe	Enable PUCCH	Enable PUSCH	Modulation	Enhanced Settings	Number of RBs	Offset RB	Conflict
0 (Not Used)							
1 (Not Used)							
2	Off	On	QPSK	...	10	2	
2	-	-	QPSK	...	0	-	
3	Off	On	QPSK	...	10	2	
4	Off	On	QPSK	...	10	2	
5 (Not Used)							
6 (Not Used)							

Each row of the table represents one subframe. If the fields in a row are unavailable for editing, the corresponding subframe is occupied by a downlink subframe or the special subframe (in TDD systems).

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Subframe Number

Shows the number of a subframe.

Note that, depending on the TDD configuration, some subframes may not be available for editing. The R&S FSV/A labels those subframes "(not used)".

Enable PUCCH

Turns the PUCCH in the corresponding subframe on and off.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:CONT` on page 188

Enable PUSCH

Turns the PUSCH in the corresponding subframe on and off.

If you turn on a PUSCH, "Modulation", "Number of RBs" and "Offset RB" become available.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:CONT` on page 188

Modulation

Selects the modulation scheme for the corresponding PUSCH allocation.

The modulation scheme is either QPSK, 16QAM, 64QAM or 256QAM.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:MODulation`
on page 189

Enhanced Settings

Opens a dialog box to configure enhanced functionality for selected channels in each subframe.

For more information see Enhanced settings.

Number of RB

Sets the number of resource blocks the PUSCH allocation covers. The number of resource blocks defines the size or bandwidth of the PUSCH allocation.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc[:CLUSter<cl>]:RBCount on page 192

Offset RB

Sets the resource block at which the PUSCH allocation begins.

Make sure not to allocate PUSCH allocations into regions reserved for PUCCH allocations.

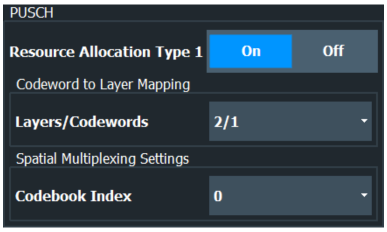
Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc[:CLUSter<cl>]:RBOFfset on page 192

5.2.4.3 Enhanced settings

The "Enhanced Settings" contain functionality to define enhanced characteristics for selected channels.

Enhanced PUSCH Configuration

Configures the PUSCH in individual subframes.



Resource Allocation Type 1

Turns a clustered PUSCH allocation on and off. If on, a second row is added to the corresponding allocation. This second row represents the second cluster.

You can define the number of resource block, the offset resource block and modulation for each cluster. All other parameters are the same for both clusters.

Precoding Settings

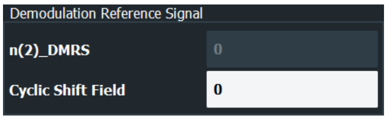
If you measure several antennas, you can define the number of layers and the codebook index for any allocation.

The number of layers of an allocation in combination with the number of code words determines the layer mapping. The available number of layers depends on the number of transmission antennas. Thus, the maximum number of layers you can select is four.

The codebook index determines the precoding matrix. The available number of indices depends on the number of transmission antennas in use. The range is from 0 to 23.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:RATO on page 191
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PRECoding:CLMapping on page 189
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PRECoding:CBINdex on page 189

Enhanced Demodulation Reference Signal Configuration
Configures the Demodulation Reference Signal in individual subframes.



n(2)_DMRS

Defines the part of the demodulation reference signal index that is part of the uplink scheduling assignment. Thus, this part of the index is valid for corresponding UE and subframe only.

The index applies when multiple shifts within a cell are used. It is used for the calculation of the DMRS sequence.

Cyclic Shift Field

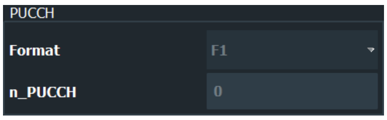
If Activate-DMRS-With OCC is on, the "Cyclic Shift Field" becomes available to define the cyclic shift field.

The Cyclic Shift Field is signaled by the PDCCH downlink channel in DCI format 0 and 4. It selects n(2)_DMRS and the orthogonal sequence (OCC) for signals according to LTE release 10.

If the "Cyclic Shift Field" is off, the demodulation reference signal is configured by the n(2)_DMRS parameter.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUSCh:NDMRs on page 191
CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUSCh:CSField on page 191

Enhanced PUCCH Configuration
Configures the PUCCH in individual subframes.



n_PUCCH

Defines the n_PUCCH parameter for the selected subframe.

Available only if you have selected "Per Subframe" for the N_PUCCH.

PUCCH Format

Selects the PUCCH format for the selected subframe.

Available only if you have selected "Per Subframe" for the Format.

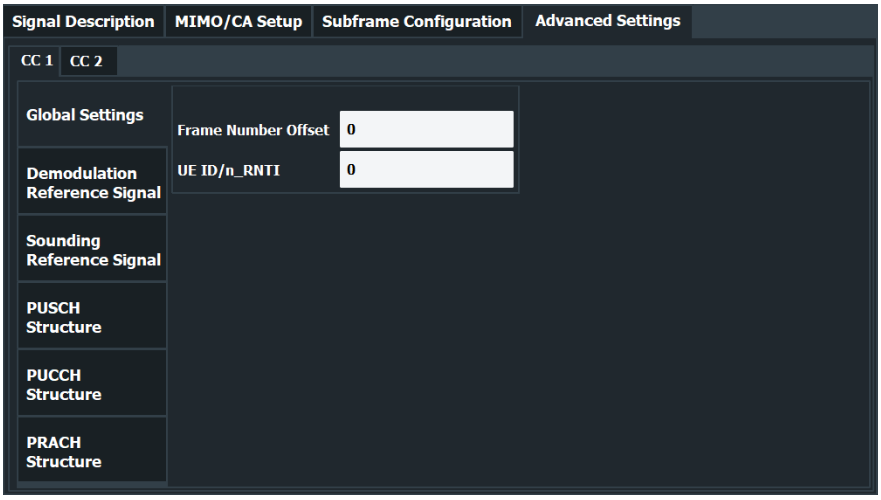
Remote command:
n_PUCCH: CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUCCh:NPAR on page 190
Format: CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUCCh:FORMat on page 190

5.2.5 Global signal characteristics

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Global Settings"

The global settings contain settings that apply to the complete signal.

The global signal settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.



Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Frame Number Offset

Defines a frame number offset for the analyzed frame.

The frame number offset assigns a number to the demodulated frame in order to identify it in a series of transmitted (and captured) frames.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:SFNO on page 193

UE ID/n_RNTI

Sets the radio network temporary identifier (RNTI) of the UE.

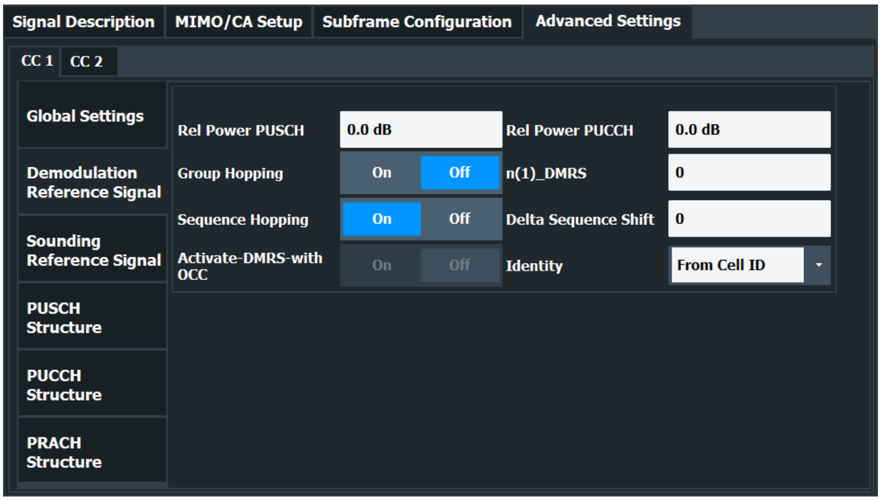
Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:UEID` on page 194

5.2.6 Demodulation reference signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Demodulation Reference Signal"

The demodulation reference signal (DRS) settings contain settings that define the physical attributes and structure of the demodulation reference signal. This reference signal helps to demodulate the PUSCH.



Functions to configure the DRS described elsewhere:

- Identity

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Relative Power PUSCH

Defines the power of the DMRS relative to the power level of the PUSCH allocation in the corresponding subframe (P_{DMRS_Offset}).

The effective power level of the DMRS depends on the allocation of the subframe and is calculated as follows.

$P_{DMRS} = P_{UE} + P_{PUSCH} + P_{DMRS\_Offset}$

The relative power of the DMRS is applied to all subframes.

The power of the PUSCH (P_{PUSCH}) may be different in each subframe.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:DRS[:PUSCh]:POWer` on page 196

Group Hopping

Turns group hopping for the demodulation reference signal on and off.

The group hopping pattern is based on 17 hopping patterns and 30 sequence shift patterns. It is generated by a pseudo-random sequence generator.

If on, PUSCH and PUCCH use the same group hopping pattern.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:DRS:GRPHopping` on page 195

Sequence Hopping

Turns sequence hopping for the uplink demodulation reference signal on and off.

Sequence hopping is generated by a pseudo-random sequence generator.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:DRS:SEQHopping` on page 196

Relative Power PUCCH

Defines the power of the DMRS relative to the power level of the PUCCH allocation in the corresponding subframe (P_{DMRS_Offset}).

The effective power level of the DMRS depends on the allocation of the subframe and is calculated as follows.

$P_{DMRS} = P_{UE} + P_{PUCCH} + P_{DMRS\_Offset}$

The relative power of the DMRS is applied to all subframes.

The power of the PUCCH (P_{PUCCH}) may be different in each subframe.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:DRS:PUCCh:POWer` on page 196

n(1)_DMRS

Defines the part of the demodulation reference signal index that is broadcast. It is valid for the whole cell.

The index applies when multiple shifts within a cell are used. It is used for the calculation of the DMRS sequence.

The n_DMRS parameter can be found in 3GPP TS36.211 V8.5.0, 5.5.2.1.1 Reference signal sequence.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:DRS:NDMRs on page 195

Delta Sequence Shift
Defines the delta sequence shift Δ_{SS}.

The standard defines a sequence shift pattern f_{ss} for the PUCCH. The corresponding sequence shift pattern for the PUSCH is a function of f_{ss}^{PUCCH} and the delta sequence shift.

For more information refer to 3GPP TS 36.211, chapter 5.5.1.3 "Group Hopping".

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:DRS:DSSHift on page 194

Activate-DMRS-With OCC
Turns the configuration of the demodulation reference signal on a subframe basis via the "Cyclic Shift Field" on and off.

If on, the "Cyclic Shift Field" becomes available. Otherwise, the demodulation reference signal is configured by the n(2)_DMRS parameter.

Note that this parameter is automatically turned on if at least one of the physical channels uses more than one antenna.

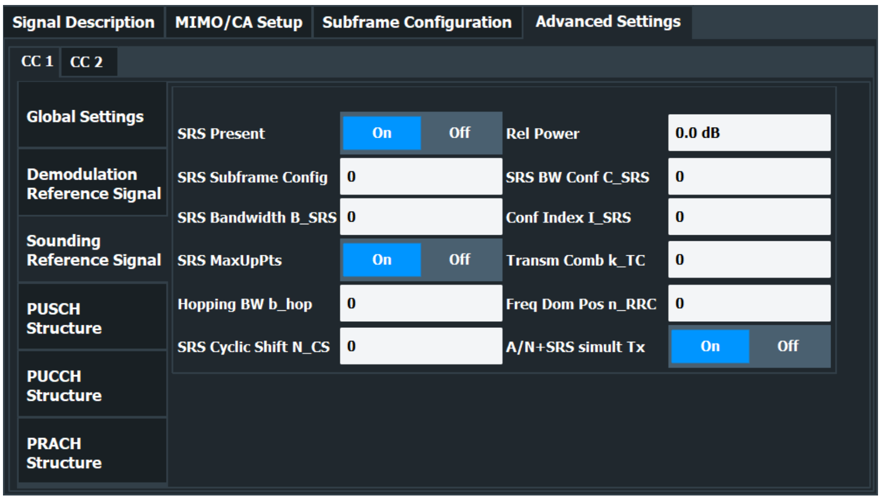
For more information see Enhanced settings and MIMO Configuration.

Remote command:
CONFigure[:LTE]:UL[:CC<cc>]:DRS:AOCC on page 194

5.2.7 Sounding reference signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Sounding Reference Signal"

The sounding reference signal (SRS) settings contain settings that define the physical attributes and structure of the sounding reference signal.



Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Present

Includes or excludes the sounding reference signal (SRS) from the test setup.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:STAT` on page 200

SRS Subframe Configuration

Defines the subframe configuration of the SRS.

The subframe configuration of the SRS is specific to a cell. The UE sends a shortened PUCCH/PUSCH in these subframes, regardless of whether the UE is configured to send an SRS in the corresponding subframe or not.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:SUConfig` on page 200

SRS MaxUpPts

Turns the parameter srs_MaxUpPts on and off.

srs_MaxUpPts controls the SRS transmission in the UpPTS field in TDD systems. If on, the SRS is transmitted in a frequency range of the UpPTS field that does not overlap with resources reserved for PRACH preamble 4 transmissions.

To avoid an overlap, the number of SRS resource blocks otherwise determined by C_SRS and B_SRS is reconfigured.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:MUPT` on page 199

SRS Bandwidth B_SRS

Defines the parameter B_{SRS}.

B_{SRS} is a UE specific parameter that defines the bandwidth of the SRS. The SRS either spans the entire frequency bandwidth or uses frequency hopping when several narrow-band SRS cover the same total bandwidth.

The standard defines up to four bandwidths for the SRS. The most narrow SRS bandwidth (B_{SRS} = 3) spans four resource blocks and is available for all channel bandwidths. The other three values of B_{SRS} define more wideband SRS bandwidths. Their availability depends on the channel bandwidth.

The availability of SRS bandwidths additionally depends on the bandwidth configuration of the SRS (C_{SRS}).

For more information refer to 3GPP TS 36.211, chapter 5.5.3.2 "Mapping to Physical Resources" for the Sounding Reference Signal.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:BSRS` on page 198

Hopping BW b_hop

Defines the parameter b_{hop}.

b_{hop} is a UE specific parameter that defines the frequency hopping bandwidth. SRS frequency hopping is active if $b_{hop} < B_{SRS}$.

For more information refer to 3GPP TS 36.211, chapter 5.5.3.2 "Mapping to Physical Resources" for the Sounding Reference Signal.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:BHOP` on page 197

SRS Cyclic Shift N_CS

Defines the cyclic shift (n_{CS}) used for the generation of the SRS CAZAC sequence.

Because the different shifts of the same Zadoff-Chu sequence are orthogonal to each other, applying different SRS cyclic shifts can be used to schedule different UE to simultaneously transmit their SRS.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:CYCS` on page 198

SRS Rel Power

Defines the power of the SRS relative to the power of the corresponding UE (P_{SRS_Offset}).

The effective power level of the SRS is calculated as follows.

$P_{SRS} = P_{UE} + P_{SRS\_Offset}$

The relative power of the SRS is applied to all subframes.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:POWer` on page 199

SRS BW Conf. C_SRS

Defines the bandwidth configuration of the SRS.

The bandwidth configuration is a cell-specific parameter that, in combination with the SRS bandwidth and the channel bandwidth, defines the length of the sounding reference signal sequence. For more information on the calculation, refer to 3GPP TS 36.211 chapter 5.5.3 "Sounding Reference Signal".

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:CSRS` on page 198

Conf. Index I_SRS

Defines the configuration index of the SRS.

The configuration index I_{SRS} is a cell specific parameter that determines the SRS periodicity (T_{SRS}) and the SRS subframe offset (T_{offset}). The effects of the configuration index on T_{SRS} and T_{offset} depends on the duplexing mode.

For more information refer to 3GPP TS 36.213, Table 8.2-1 (FDD) and 8.2-2 (TDD).

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:ISRS` on page 199

Transm. Comb. k_TC

Defines the transmission comb k_{TC}.

The transmission comb. is a UE specific parameter. For more information refer to 3GPP TS 36.211, chapter 5.5.3.2 "Mapping to Physical Resources" for the Sounding Reference Signal.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:TRComb` on page 200

Freq. Domain Pos. n_RRC

Defines the parameter n_{RRC}.

n_{RRC} is a UE specific parameter and determines the starting physical resource block of the SRS transmission.

For more information refer to 3GPP TS 36.211, chapter 5.5.3.2 "Mapping to Physical Resources" for the Sounding Reference Signal.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:NRRC` on page 199

A/N + SRS Simultaneous TX

Turns simultaneous transmission of the Sounding Reference Signal (SRS) and ACK/NACK messages (via PUCCH) on and off.

By turning the parameter on, you allow for simultaneous transmission of PUCCH and SRS in the same subframe.

If off, the SRS not transmitted in the subframe for which you have configured simultaneous transmission of PUCCH and SRS.

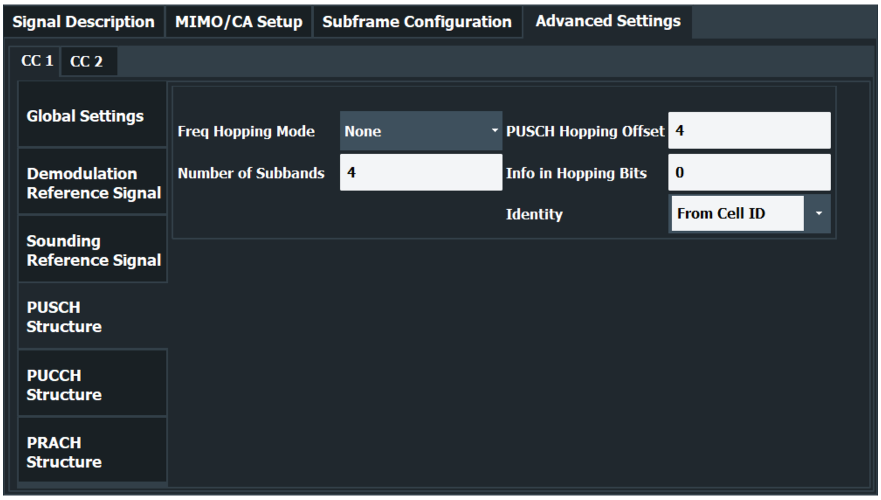
Note that simultaneous transmission of SRS and PUCCH is available only if the PUCCH format is either 1, 1a, 1b or 3. The other PUCCH formats contain CQI reports which are not transmitted with the SRS.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:SRS:ANST` on page 197

5.2.8 PUSCH structure

Access: "Overview" > "Signal Description" > "Advanced Settings" > "PUSCH Structure"

The PUSCH structure settings contain settings that describe the physical attributes and structure of the PUSCH.



Functions to configure the PUSCH described elsewhere:

- Identity

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Frequency Hopping Mode

Selects the frequency hopping mode of the PUSCH.

Several hopping modes are supported.

- None
  No frequency hopping.
- Inter Subframe Hopping
  PUSCH changes the frequency from one subframe to another.
- Intra Subframe Hopping
  PUSCH also changes the frequency within a subframe.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHMode` on page 201

Number of Subbands
Defines the number of subbands reserved for PUSCH.

For more information refer to 3GPP TS 36.211, chapter 5.5.3.2 "Mapping to Physical Resources" for the Sounding Reference Signal.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:NOSM` on page 202

PUSCH Hopping Offset
Defines the PUSCH Hopping Offset N_{RB}^{HO}.

The PUSCH Hopping Offset determines the first physical resource block and the maximum number of physical resource blocks available for PUSCH transmission if PUSCH frequency hopping is active.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHOFfset` on page 201

Info. in Hopping Bits
Defines the information available in the hopping bits according to the PDCCH DCI format 0 hopping bit definition.

The information in the hopping bits determines whether type 1 or type 2 hopping is used in the subframe and, in case of type 1, additionally determines the exact hopping function to use.

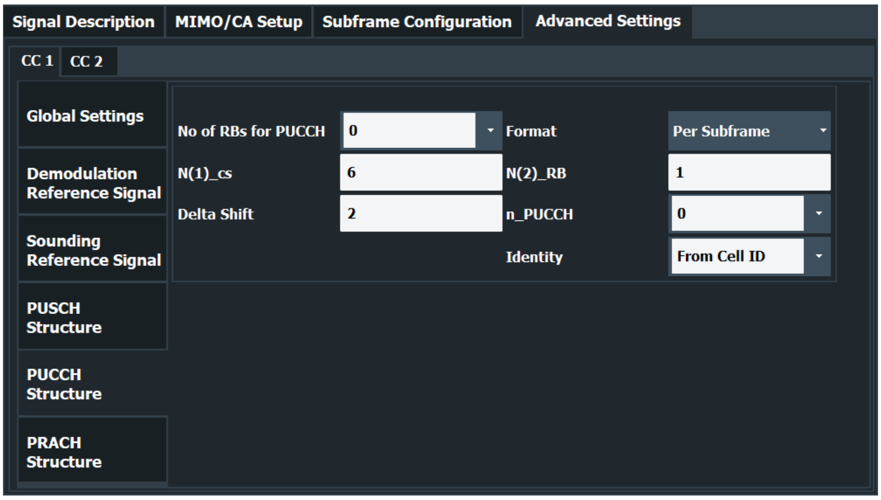
For more information on PUSCH frequency hopping refer to 3GPP TS36.213.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHOP:IIHB` on page 202

5.2.9 PUCCH structure

Access: "Overview" > "Signal Description" > "Advanced Settings" > "PUCCH Structure"

The PUCCH structure settings contain settings that describe the physical attributes and structure of the PUCCH.



Functions to configure the PUCCH described elsewhere:

- Identity

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

No. of RBs for PUCCH

Defines the number of resource blocks reserved for PUCCH.

The resource blocks for PUCCH are always allocated at the edges of the LTE spectrum.

In case of an even number of PUCCH resource blocks, half of the available PUCCH resource blocks is allocated on the lower, the other half on the upper edge of the LTE spectrum (outermost resource blocks).

In case of an odd number of PUCCH resource blocks, the number of resource blocks on the lower edge is one resource block larger than the number of resource blocks on the upper edge of the LTE spectrum.

If you select the "Auto" menu item, the application automatically detects the number of RBs.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:NORB` on page 204

N(1)_cs
Defines the number of cyclic shifts used for PUCCH format 1/1a/1b in a resource block used for a combination of the formats 1/1a/1b and 2/2a/2b.

Only one resource block per slot can support a combination of the PUCCH formats 1/1a/1b and 2/2a/2b.

The number of cyclic shifts available for PUCCH format 2/2a/2b N(2)_cs in a block with combination of PUCCH formats is calculated as follows.

N(2)_cs = 12 - N(1)_cs - 2

For more information refer to 3GPP TS36.211, chapter 5.4 "Physical Uplink Control Channel".

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:N1CS` on page 204

Delta Shift
Defines the delta shift parameter.

The delta shift is the difference between two adjacent PUCCH resource indices with the same orthogonal cover sequence (OC).

It determines the number of available sequences in a resource block that can be used for PUCCH formats 1/1a/1b.

For more information refer to 3GPP TS36.211, chapter 5.4 "Physical Uplink Control Channel".

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:DESHift` on page 203

Format
Selects the format of the PUCCH.

You can define the PUCCH format for all subframes or define the PUCCH format for each subframe individually.

- F1, F1a, F1b, F2, F2a, F2b, F3
  Selects the PUCCH format globally for every subframe.
- Per Subframe
  You can select the PUCCH format for each subframe separately in the Enhanced settings of the "Subframe Configuration".

Note that formats F2a and F2b are only supported for normal cyclic prefix length.

For more information refer to 3GPP TS36.211, table 5.4-1 "Supported PUCCH Formats".

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:FORMat` on page 203

N(2)_RB
Defines bandwidth in terms of resource blocks that are reserved for PUCCH formats 2/2a/2b transmission in each subframe.

Since there can be only one resource block per slot that supports a combination of the PUCCH formats 1/1a/1b and 2/2a/2b, the number of resource block(s) per slot available for PUCCH format 1/1a/1b is determined by N(2)_RB.

For more information refer to 3GPP TS36.211, chapter 5.4 "Physical Uplink Control Channel".

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:N2RB` on page 204

N_PUCCH
Defines the resource index for PUCCH format 1/1a/1b respectively 2/2a/2b.

You can select the PUCCH format manually or allow the application to determine the PUCCH format automatically based on the measurement.

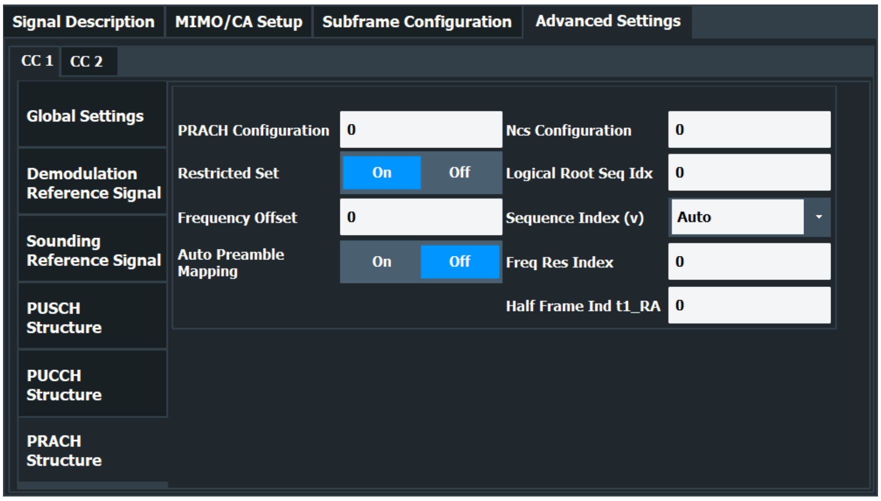
It is also possible to define N_{PUCCH} on a subframe level by selecting the "Per Subframe" menu item. For more information see Chapter 5.2.4, "Subframe configuration", on page 61.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:NPAR` on page 205

5.2.10 PRACH structure

Access: "Overview" > "Signal Description" > "Advanced Settings" > "PRACH Structure"

The PRACH structure settings contain settings that describe the physical attributes and structure of the PRACH.



Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PRACH Configuration

Sets the PRACH configuration index as defined in the 3GPP TS 36.211, i.e. defines the subframes in which random access preamble transmission is allowed.

The preamble format is automatically derived from the PRACH Configuration.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:CONF` on page 206

Restricted Set

This command turns the restricted preamble set on and off.

A restricted preamble set corresponds to high speed mode. An unrestricted preamble set to normal mode.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:RSET` on page 208

Frequency Offset

The "Frequency Offset" defines the PRACH frequency offset for preamble formats 0 to 3 as defined in the 3GPP TS 36.211. The frequency offset determines the first physical resource block available for PRACH expressed as a physical resource block number.

Remote command:

`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:FOFFset` on page 206

PRACH Preamble Mapping

The frequency resource index f_{RA} and the half frame indicator $t1_{RA}$ are necessary for clear specification of the physical resource mapping of the PRACH, in case a PRACH configuration index has more than one mapping alternative.

If you turn on the "Auto Preamble Mapping", the R&S FSV/A automatically detects f_{RA} and $t1_{RA}$.

The values for both parameters are defined in table '5.7.1-4: Frame structure type 2 random access preamble mapping in time and frequency' (3GPP TS 36.211 v10.2.0).

The frequency resource index and half frame indicator are available in TDD mode.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:APM` on page 206
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:FRINdex` on page 206
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:HFINdicator` on page 207

Ncs Conf
Selects the Ncs configuration, i.e. determines the Ncs value set according to TS 36.211, table 5.7.2.-2 and 5.7.2-3.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:NCSC` on page 207

Logical Root Sequ. Idx
Selects the logical root sequence index.

The logical root sequence index is used to generate PRACH preamble sequences. It is provided by higher layers.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:RSEQ` on page 207

Sequence Index (v)
Defines the sequence index (v).

The sequence index controls which of the 64 preambles available in a cell is used.

If you select the "Auto" menu item, the software automatically selects the required sequence index.

Remote command:
`CONFigure[:LTE]:UL[:CC<cc>]:PRACh:SINDex` on page 208

5.2.11 Input source configuration

The R&S FSV/A supports several input sources and outputs.

For a comprehensive description of the supported inputs and outputs, refer to the R&S FSV/A user manual.

5.2.11.1 RF input

Access: "Overview" > "Input / Frontend" > "Input Source" > "Radio Frequency"

Functions to configure the RF input described elsewhere:

- "Input Coupling" on page 87
- "Impedance" on page 87

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option R&S FSV3-B11 on the R&S FSV/A.

An internal YIG-preselector at the input of the R&S FSV/A ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis, you can disable the YIG-preselector at the input of the R&S FSV/A, which can lead to image-frequency display.

Note: Note that the YIG-preselector is active only on frequencies greater than 7.5 GHz. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.
For frequencies above 50 GHz (requires option R&S FSV3-B54G, for R&S FSVA3050 only), the YIG-preselector is automatically switched off (internally, not indicated in the display). In this case, image frequencies can occur, as specified in the specifications document.

Remote command:
`INPut:FILTer:YIG[:STATe]` on page 209

5.2.11.2 External frontends

Access: "Overview" > "Input / Frontend" > "Input Source" > "Ext. Frontend"

Controlling external frontends is available with the optional external frontend control. The functionality is the same as in the I/Q analyzer application.

For more information about using external frontends, refer to the R&S FSV/A I/Q analyzer user manual.

5.2.11.3 I/Q file

Access: "Overview" > "Input / Frontend" > "Input Source" > "I/Q File"

As an alternative to capturing the measurement (I/Q) data live, you can also load previously recorded I/Q data stored in an `iq.tar` file. The file is then used as the input source for the application.

Available for I/Q based measurements.

For details, see the user manual of the I/Q analyzer.

I/Q Input File State
Enables input from the selected I/Q input file.

If enabled, the application performs measurements on the data from this file. Thus, most measurement settings related to data acquisition (attenuation, center frequency, measurement bandwidth, sample rate) cannot be changed. The measurement time can only be decreased to perform measurements on an extract of the available data only.

Note: Even when the file input is disabled, the input file remains selected and can be enabled again quickly by changing the state.

Remote command:
`INPut:SELect` on page 210

Select I/Q data file
Opens a file selection dialog box to select an input file that contains I/Q data.

The I/Q data must have a specific format (`.iq.tar`) as described in R&S FSV/A I/Q Analyzer and I/Q Input user manual.

The default storage location for I/Q data files is `C:\R_S\INSTR\USER`.

Remote command:
`INPut:FILE:PATH` on page 208

File Repetitions
Determines how often the data stream is repeatedly copied in the I/Q data memory to create a longer record. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Remote command:
`TRACe:IQ:FILE:REPetition:COUNt` on page 211

Selected Channel
Only available for files that contain more than one data stream from multiple channels: selects the data stream to be used as input for the currently selected channel.

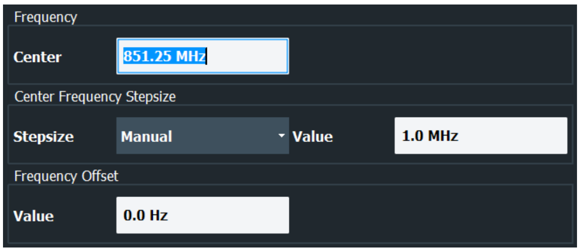
In "Auto" mode (default), the first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

Remote command:
`MMEMory:LOAD:IQ:STReam` on page 210
`MMEMory:LOAD:IQ:STReam:AUTO` on page 210
`MMEMory:LOAD:IQ:STReam:LIST?` on page 211

5.2.12 Frequency configuration

Access: "Overview" > "Input / Frontend" > "Frequency"

Frequency settings define the frequency characteristics of the signal at the RF input. They are part of the "Frequency" tab of the "Signal Characteristics" dialog box.



The remote commands required to configure the frequency are described in Chapter 7.10.2.3, "Frequency configuration", on page 211.

Signal Frequency

For measurements with an RF input source, you have to match the **center frequency** of the analyzer to the frequency of the signal.

Center Frequency ← Signal Frequency

Defines the center frequency of the signal and thus the frequency the R&S FSV/A tunes to.

The frequency range depends on the hardware configuration of the analyzer you are using.

Remote command:
Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 211
Frequency offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 212

Frequency Stepsize ← Signal Frequency

In addition to the frequency itself, you can also define a frequency stepsize. The frequency stepsize defines the extent of a frequency change if you change it, for example with the rotary knob.

You can define the stepsize in two ways.

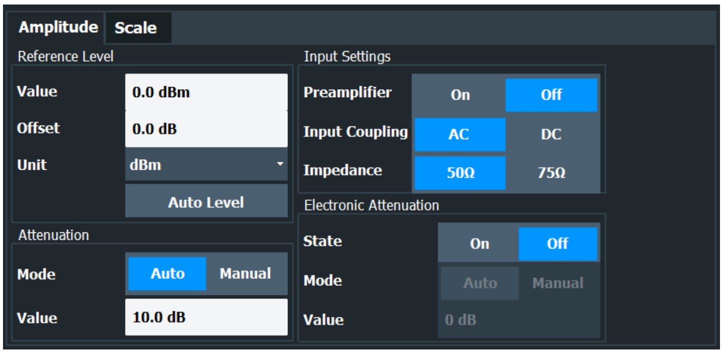
- = Center
  One frequency step corresponds to the current center frequency.
- Manual
  Define any stepsize you need.

Remote command:
Frequency stepsize: `[SENSe:]FREQuency:CENTer:STEP` on page 212

5.2.13 Amplitude configuration

Access: "Overview" > "Input / Frontend" > "Amplitude"

Amplitude settings define the expected level characteristics of the signal at the RF input.



The remote commands required to configure the amplitude are described in Chapter 7.10.2.4, "Amplitude configuration", on page 213.

Reference Level

The reference level is the power level the analyzer expects at the RF input. Keep in mind that the power level at the RF input is the peak envelope power for signals with a high crest factor like LTE.

To get the best dynamic range, you have to set the reference level as low as possible. At the same time, make sure that the maximum signal level does not exceed the reference level. If it does, it will overload the A/D converter, regardless of the signal power. Measurement results can deteriorate (e.g. EVM), especially for measurements with more than one active channel near the one you are trying to measure (± 6 MHz).

Note that the signal level at the A/D converter can be stronger than the level the application displays, depending on the current resolution bandwidth. This is because the resolution bandwidths are implemented digitally after the A/D converter.

The reference level is a value in dBm.

Remote command:
Reference level: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel` on page 213

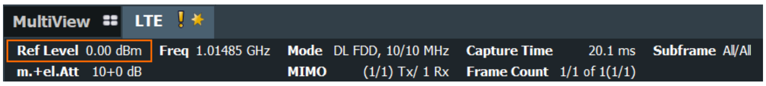
Auto Level ← Reference Level

Automatically determines the ideal reference level. The automatic leveling process measures the signal and defines the ideal reference signal for the measured signal.

Automatic level detection also optimizes RF attenuation.

Auto leveling slightly increases the measurement time, because of the extra leveling measurement prior to each sweep. By default, the R&S FSV/A automatically defines the time for auto leveling, but you can also define it manually ([Auto Set] > "Auto Level Config" > "Meas Time").

The application shows the current reference level (including RF and external attenuation) in the channel bar.



Remote command:
Automatic: [SENSe:]ADJust:LEVel<ant> on page 228
Auto level mode: [SENSe:]ADJust:CONFigure:LEVel:DURation:MODE on page 227
Auto level time: [SENSe:]ADJust:CONFigure:LEVel:DURation on page 227

Reference Level Offset ← Reference Level
The reference level offset is an arithmetic level offset. A level offset is useful if the signal is attenuated or amplified before it is fed into the analyzer. All displayed power level results are shifted by this value. Note however, that the reference value ignores the level offset. Thus, it is still mandatory to define the actual power level that the analyzer has to handle as the reference level.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet on page 214

Attenuating the Signal
Attenuation of the signal becomes necessary if you have to reduce the power of the signal that you have applied. Power reduction is necessary, for example, to prevent an overload of the input mixer.

For a comprehensive information about signal attenuation, refer to the user manual of the R&S FSV/A.

The LTE measurement application provides several attenuation modes.

RF Attenuation ← Attenuating the Signal
Controls the RF (or mechanical) attenuator at the RF input.

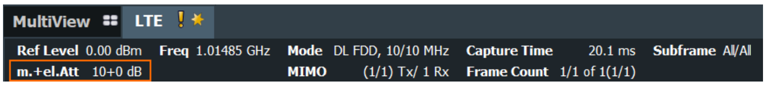
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Note that when you are using an external frontend, you can define attenuation for the analyzer and the external frontend separately. For more information about external frontends, refer to the user manual of the I/Q analyzer.

The application shows the attenuation level (mechanical and electronic) in the channel bar.



Remote command:
State: `INPut:ATTenuation<ant>:AUTO` on page 214
Level: `INPut:ATTenuation<ant>` on page 214

Electronic Attenuation ← Attenuating the Signal
Controls the optional electronic attenuator.

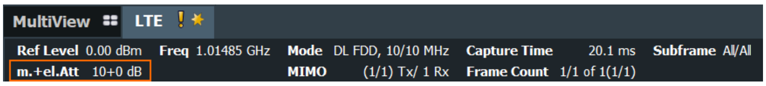
If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Note that the frequency range must not exceed the specification of the electronic attenuator for it to work.

The application shows the attenuation level (mechanical and electronic) in the channel bar.



Remote command:
Electronic attenuation: `INPut:EATT<ant>:STATe` on page 217
Electronic attenuation: `INPut:EATT<ant>:AUTO` on page 216
Electronic attenuation: `INPut:EATT<ant>` on page 216

Preamplifier
If the (optional) internal preamplifier hardware is installed on the R&S FSV/A, a preamplifier can be activated for the RF input signal.

You can use a preamplifier to analyze signals from DUTs with low output power.

For an active external frontend, a preamplifier is not available.

For R&S FSV/A, the following settings are available:

"Off"	Deactivates the preamplifier.
"15 dB"	The RF input signal is amplified by about 15 dB.
"30 dB"	The RF input signal is amplified by about 30 dB.
"On"	Using the preamplifier with the option number 1330.3465.02: the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSV/A3044 models, the preamplifier is only available under the following conditions:
- In zero span, the maximum center frequency is 43.5 GHz
- For frequency spans, the maximum stop frequency is 43.5 GHz
- For I/Q measurements, the maximum center frequency depends on the analysis bandwidth:

$f_{center} \leq 43.5$ GHz - (<Analysis_bw> / 2)

If any of the conditions no longer apply after you change a setting, the preamplifier is automatically deactivated.

Remote command:
`INPut:GAIN:STATe` on page 215
`INPut:GAIN[:VALue]` on page 215

Input Coupling
The RF input of the R&S FSV/A can be coupled by alternating current (AC) or direct current (DC).

For an active external frontend, input coupling is always AC.

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the specifications document.

Remote command:
`INPut:COUPling` on page 215

Impedance
For some measurements, the reference impedance for the measured levels of the R&S FSV/A can be set to 50 Ω or 75 Ω.

For an active external frontend, impedance is always 50 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/ 50Ω).

This value also affects the unit conversion.

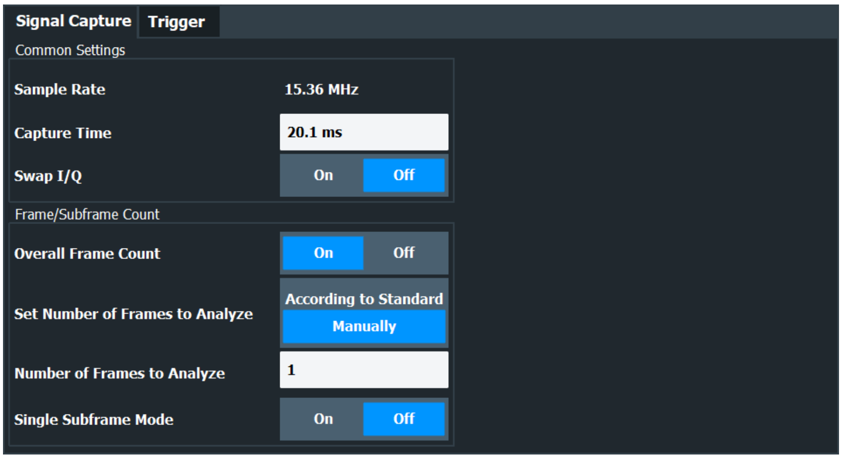
Remote command:
`INPut:IMPedance` on page 216

5.2.14 Data capture

Access: "Overview" > "Trig / Sig Capture" > "Signal Capture"

The data capture settings contain settings that control the data capture.

The data capture settings are part of the "Signal Capture" tab of the "Trigger/Signal Capture" dialog box.

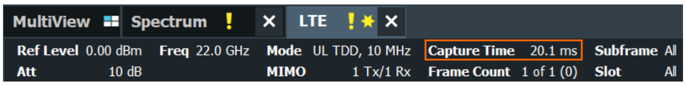


Capture Time

The "Capture Time" corresponds to the time of one measurement. Therefore, it defines the amount of data the application captures during a single measurement (or sweep).

By default, the application captures 20.1 ms of data to make sure that at least one complete LTE frame is captured in the measurement.

The application shows the current capture time in the channel bar.



Remote command:
[SENSe:]SWEep:TIME on page 219

Swap I/Q

Swaps the real (I branch) and the imaginary (Q branch) parts of the signal.

Remote command:
[SENSe:]SWAPiq on page 218

Overall Frame Count

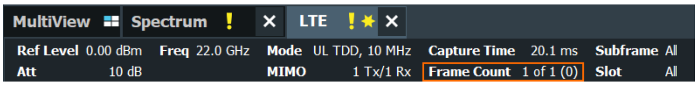
The "Overall Frame Count" turns the manual selection of the number of frames to capture (and analyze) on and off.

When you turn on the overall frame count, you can define the number of frames to capture and analyze. The measurement runs until all frames have been analyzed, even if it takes more than one capture.

The results are an average of the captured frames.

When you turn off the overall frame count, the application analyzes all LTE frames found in one capture buffer.

The application shows the current frame count in the channel bar.



Remote command:
[SENSe:][LTE:]FRAMe:COUNt:STATe on page 218

Auto According to Standard
Turns automatic selection of the number of frames to capture and analyze on and off.

When you turn on this feature, the R&S FSV/A captures and evaluates a number of frames the 3GPP standard specifies for EVM tests.

If you want to analyze an arbitrary number of frames, turn off the feature.

This parameter is not available when the overall frame count is inactive.

Remote command:
[SENSe:][LTE:]FRAMe:COUNt:AUTO on page 218

Number of Frames to Analyze
Defines the number of frames you want to capture and analyze.

If the number of frames you have set last longer than a single measurement, the application continues the measurement until all frames have been captured.

The parameter is read only in the following cases:
- If you turn off the overall frame count.
- If you capture the data according to the standard.

Remote command:
[SENSe:][LTE:]FRAMe:COUNt on page 217

Single Subframe Mode
Turns the evaluation of a single subframe only on and off.

Evaluating a single subframe only improves the measurement speed. For successful synchronization, the subframe must be located within the captured data (= 1.2 ms). You can make sure that this is the case by using, for example, an external frame trigger signal.

For maximum measurement speed, the application turns off Auto According to Standard and sets the Number of Frames to Analyze to 1. These settings prevent the application from capturing data more than once for a single run measurement.

Remote command:
[SENSe:][LTE:]FRAMe:SSUBframe on page 218

5.2.15 Trigger configuration

Access: "Overview" > "Trig / Sig Capture" > "Trigger"

A trigger allows you to capture those parts of the signal that you are really interested in.

While the application runs freely and analyzes all signal data in its default state, no matter if the signal contains information or not, a trigger initiates a measurement only under certain circumstances (the trigger event).

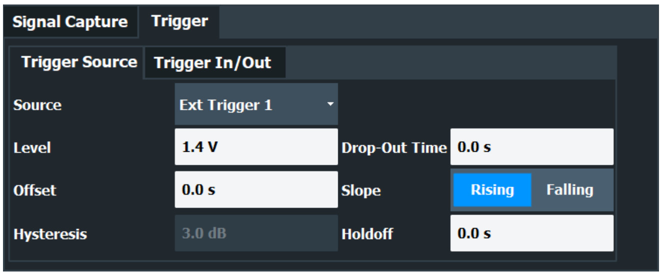
Except for the available trigger sources, the functionality is the same as that of the R&S FSV/A base system.

For a comprehensive description of the available trigger settings not described here, refer to the documentation of the R&S FSV/A.

Gated measurements

In addition to the general trigger functions, the frequency sweep measurements (for example ACLR) also support gated measurements.

The functionality is basically the same as in the spectrum application. However, the LTE application automatically selects the correct gate settings (delay and length) according to the TDD configuration.



Trigger Source

The application supports several trigger modes or sources.

- **Free Run**
  Starts the measurement immediately and measures continuously.
- **External <x>**
  The trigger event is the level of an external trigger signal. The measurement starts when this signal meets or exceeds a specified trigger level at the trigger input.
  Some measurement devices have several trigger ports. When you use one of these, several external trigger sources are available.
- **I/Q Power**
  The trigger event is the magnitude of the sampled I/Q data. The measurement starts when the magnitude of the I/Q data meets or exceeds the trigger level.
- **IF Power**
  The trigger event is the level of the intermediate frequency (IF). The measurement starts when the level of the IF meets or exceeds the trigger level.
- **RF Power**
  The trigger event is the level measured at the RF input. The measurement starts when the level of the signal meets or exceeds the trigger level.

For all trigger sources, except "Free Run", you can define several trigger characteristics.

- The trigger "Level" defines the signal level that initiates the measurement.

- The trigger "Offset" is the time that must pass between the trigger event and the start of the measurement. This can be a negative value (a pretrigger).
- The trigger "Drop-out Time" defines the time the input signal must stay below the trigger level before triggering again.
- The trigger "Slope" defines whether triggering occurs when the signal rises to the trigger level or falls down to it.
- The trigger "Holdoff" defines a time period that must at least pass between one trigger event and the next.
- The trigger "Hysteresis" is available for the IF power trigger. It defines a distance to the trigger level that the input signal must stay below to fulfill the trigger condition.

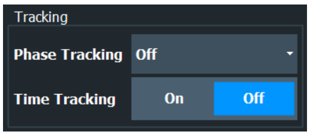
For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 223
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 221
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 221
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 221
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 222
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 220
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 220
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 219
Slope: `TRIGger[:SEQuence]:SLOPe` on page 223
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 220

5.2.16 Tracking configuration

Access: "Overview" > "Signal Description" > "Tracking"

The tracking settings contain settings that compensate for various common measurement errors that may occur.



Phase

Turns phase tracking on and off.

When you turn on phase tracking, the application compensates the measurement results for the phase error on a symbol level.

"Off"	Phase tracking is not applied.
"Pilot Only"	Only the reference signal is used for the estimation of the phase error.

"Pilot and Payload" Both reference signal and payload resource elements are used for the estimation of the phase error.

Remote command:
`[SENSe:][LTE:]UL:TRACking:PHASe` on page 226

Time Tracking
Turns time tracking on and off.

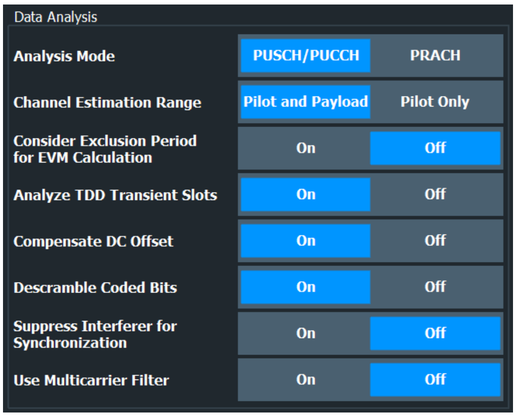
Clock deviations (slower or faster sampling time) lead to a drift of the ideal sampling instant over time, causing a rotating constellation diagram.

When you turn on time tracking, the application compensates the measurement results for timing errors on a symbol level.

Remote command:
`[SENSe:][LTE:]UL:TRACking:TIME` on page 227

5.2.17 Signal demodulation

Access: "Overview" > "Demodulation"



Analysis Mode
Selects the channel analysis mode.

You can select from "PUSCH/PUCCH" mode and "PRACH" mode.

"PUSCH/PUCCH" mode analyzes the PUSCH and PUCCH (default mode).

"PRACH" mode analyzes the PRACH only. In PRACH analysis mode, no subframe or slot selection is available. Instead you can select a particular preamble that the results are shown for. Note that PRACH analysis mode does not support all result displays.

Remote command:
[SENSe:][LTE:]UL:DEMod:MODE on page 224

Channel Estimation Range
Selects the method for channel estimation.

You can select if only the pilot symbols are used to perform channel estimation or if both pilot and payload carriers are used.

Remote command:
[SENSe:][LTE:]UL:DEMod:CESTimation on page 225

EVM with Exclusion Period
Turns exclusion periods for EVM measurements as defined in 3GPP TS 36.521 on and off.

The exclusion period affects the PUSCH data EVM of the first and last symbol.

The software automatically determines the length of the exclusion period according to 3GPP TS 36.521-1.

The exclusion period has no effect on the EVM vs Carrier and EVM vs Symbol x Carrier result displays.

Remote command:
[SENSe:][LTE:]UL:DEMod:EEPeriod on page 225

Analyze TDD Transient Slots
Includes or excludes the transient slots present after a switch from downlink to uplink in the analysis.

If on, the transient slots are not included in the measurement.

Remote command:
[SENSe:][LTE:]UL:DEMod:ATTSlots on page 224

Compensate DC Offset
Turns DC offset compensation when calculating measurement results on and off.

According to 3GPP TS 36.101 (Annex F.4), the R&S FSV/A removes the carrier leakage (I/Q origin offset) from the evaluated signal before it calculates the EVM and in-band emissions.

Remote command:
[SENSe:][LTE:]UL:DEMod:CDCoffset on page 225

Scrambling of Coded Bits
Turns the scrambling of coded bits for the PUSCH on and off.

The scrambling of coded bits affects the bitstream results.

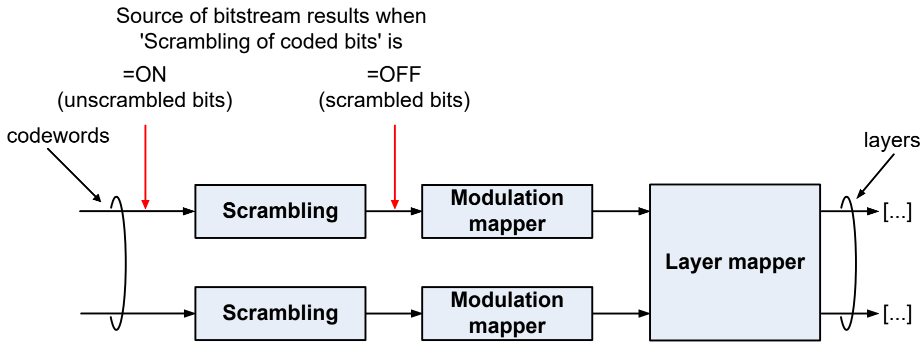


Figure 5-1: Source for bitstream results if scrambling for coded bits is on and off

Remote command:
[SENSe:][LTE:]UL:DEMod:CBSCrambling on page 225

Suppressed Interference Synchronization
Turns suppressed interference synchronization on and off.

If active, the synchronization on signals containing more than one user equipment (UE) is more robust. Additionally, the EVM is lower in case the UEs have different frequency offsets. Note that Auto Demodulation is not supported in this synchronization mode and the EVM may be higher in case only one UE is present in the signal.

Remote command:
[SENSe:][LTE:]UL:DEMod:SISYnc on page 226

Multicarrier Filter
Turns the suppression of interference of neighboring carriers on and off.

The R&S FSV/A automatically selects the multicarrier filter when you analyze more than 1 component carrier.

Remote command:
[SENSe:][LTE:]UL:DEMod:MCFilter on page 226

5.2.18 Automatic configuration

Access: [AUTO SET]

The R&S FSV/A features several automatic configuration routines. When you use one of those, the R&S FSV/A configures different parameters based on the signal that you are measuring.

Auto leveling
You can use the auto leveling routine for a quick determination of preliminary amplitude settings for the current LTE input signal.

Remote command:
[SENSe:]ADJust:LEVel<ant> on page 228

Auto Scaling
Scales the y-axis for best viewing results. Also see "Automatic scaling of the y-axis" on page 101.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO` on page 237

5.3 Time alignment error measurements

Several settings supported by time alignment error measurements are the same as those for I/Q measurements. For a comprehensive description of those, refer to the following chapters.

- Chapter 5.2.1, "Signal characteristics", on page 52
- Chapter 5.2.6, "Demodulation reference signal configuration", on page 68
- Chapter 5.2.8, "PUSCH structure", on page 74
- Chapter 7.10.2.2, "Input configuration", on page 208
- Chapter 5.2.12, "Frequency configuration", on page 82
- Chapter 5.2.13, "Amplitude configuration", on page 83
- Chapter 5.2.14, "Data capture", on page 87
- Chapter 5.2.15, "Trigger configuration", on page 89
- Chapter 5.2.17, "Signal demodulation", on page 92

For more information about configuring carrier aggregation see "Carrier Aggregation" on page 53.

5.4 Frequency sweep measurements

After starting one of the frequency sweep measurements, the application automatically loads the configuration required by measurements according to the 3GPP standard: the spectral mask as defined in the 3GPP standard for SEM measurements and the channel configuration defined in the standard for the ACLR measurement.

If you need a different measurement configuration, you can change all parameters as required. Except for the dialog box described below, the measurement configuration menus for the frequency sweep measurements are the same as in the spectrum application.

Refer to the user manual of the R&S FSV/A for a detailed description on how to configure ACLR and SEM measurements.

Filter type in SEM measurements

The 5G NR application uses a channel filter for SEM measurements by default. The spectrum application on the other hand uses a Gauss filter. If you need a Gauss filter for the SEM measurement in the 5G NR application, change it manually in the sweep list for the corresponding frequency ranges.

5.4.1 ACLR signal description

Access: [MEAS CONFIG] > "Signal Description"

The signal description for ACLR measurements contains settings to describe general physical characteristics of the signal you are measuring.

Functions in the "Signal Description" dialog box described elsewhere:

- LTE mode
- Test Model
- Channel bandwidth

All other settings available for the ACLR measurement are the same as in the spectrum application. For more information, refer to the user manual of the R&S FSV/A.

Assumed Adjacent Channel Carrier

Selects the assumed adjacent channel carrier for the ACLR measurement.

The supported types are EUTRA of same bandwidth, 1.28 Mcps UTRA, 3.84 Mcps UTRA and 7.68 Mcps UTRA.

Note that not all combinations of LTE channel bandwidth settings and assumed adjacent channel carrier settings are defined in the 3GPP standard.

Remote command:
`[SENSe:]POWer:ACHannel:AACHannel` on page 231

5.4.2 SEM signal description

The signal description for SEM measurements contains settings to describe general physical characteristics of the signal you are measuring.

Access: "Overview" > "Signal Description"

Functions in the "Signal Description" dialog box described elsewhere:

- LTE mode
- Test Model
- Channel bandwidth

- Cyclic prefix
- TDD configuration

All other settings available for the SEM measurement are the same as in the spectrum application. For more information, refer to the user manual of the R&S FSV/A.

SEM Requirement
Selects the type of spectrum emission mask used for the Out of Band emission measurement.

The software supports general and specific (additional) spectrum emission masks. The specific spectrum emission masks contain additional SEM requirements. The additional requirement masks to use for the measurement depend on the network signaled value "NS_03", "NS_04", "NS_06" or "NS_07".

If "NS_06" or "NS_07" is indicated in the cell, use SEM requirement "NS_06_07".

Remote command:
`[SENSe:]POWer:SEM:UL:REQuirement` on page 231

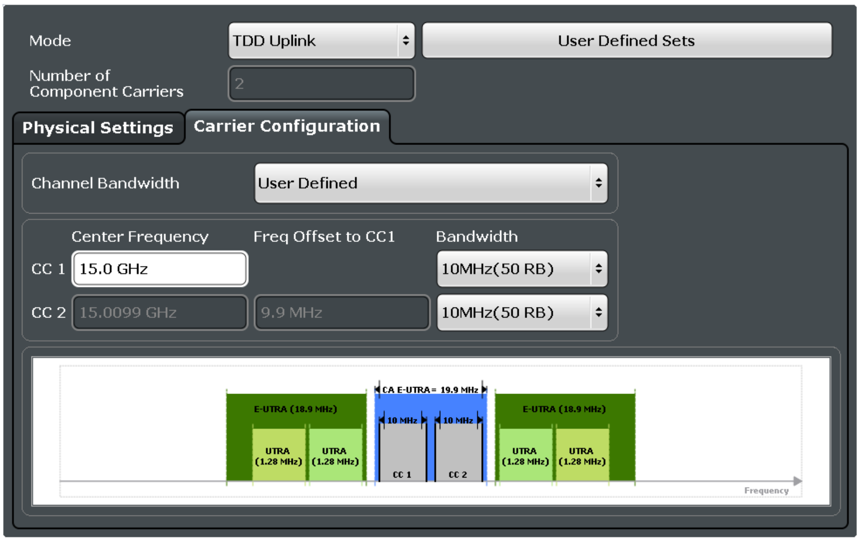
5.4.3 MC ACLR signal description

Access: "Overview" > "Signal Description" > "Physical Settings CC<x>" / "Carrier Configuration"

You can configure the characteristics of the carriers in the "Carrier Configuration" tab.

Note: the "Carrier Configuration" button in the "Physical Settings" tab also opens the "Carrier Configuration" tab.

The signal description for MC ACLR measurements contain settings to describe general physical characteristics of the signal you are measuring.



Functions in the "Signal Description" dialog box described elsewhere:

- LTE mode

- Test Model
- Channel bandwidth
- Cyclic prefix
- TDD configuration
- Component carriers

6 Analysis

The R&S FSV/A provides various tools to analyze the measurement results.

6.1 General analysis tools

The general analysis tools are tools available for all measurements.

6.1.1 Data export

Access: [TRACE] > "Trace Export Config"

You can export the measurement results to an ASCII file, for example to backup the results or analyze the results with external applications (for example in a Microsoft Excel spreadsheet).

You can also export the I/Q data itself, for example if you want to keep it for later reevaluation.

The data export is available for:

- I/Q measurements
- Time alignment error measurements

Exporting trace data

1. Select [TRACE] > "Trace Export Config".
2. Select the data you would like to export.
3. Select the results you would like to export from the "Specifics For" dropdown menu.
4. Export the data with the "Export Trace to ASCII File" feature.
5. Select the location where you would like to save the data (as a `.dat` file).

   Note that the measurement data stored in the file depend on the selected result display ("Specifics For" selection).

Exporting I/Q data

1. Select the disk icon in the toolbar.

2. Select "Export" > "I/Q Export".
3. Define a file name and location for the I/Q data.
   The default file type is iq.tar.
4. Later on, you can import the I/Q data using the I/Q file input source.

Data import and export
The basic principle for both trace export and I/Q data export and import is the same as in the spectrum application. For a comprehensive description, refer to the R&S FSV/A user manual.

For the I/Q data export, you can choose between different file formats (.iq.tar, .aid, .csv, .iqw and .mat (v4 and v7.3) for single carrier measurements.

Remote command:
Trace export: TRACe<n>[:DATA]? on page 144
I/Q data format: FORMat:DEXPort:FORMat on page 179
I/Q export: MMEMory:STORe<n>:IQ:STATe on page 179
I/Q import: INPut:FILE:PATH on page 208

6.1.2 Microservice export

Access: / > "Export" > "Microservice Export"

In addition to exporting the signal configuration locally, you can export the signal configuration in a file format compatible to the cloud-based microservice (.m5g file extension).

For a comprehensive description of the microservice, refer to the microservice user manual.

Remote command:

MMEMory:STORe<n>:MSERvice on page 234

6.1.3 Diagram scale

Access: "Overview" > "Analysis" > "Scale"

You can change the scale of the y-axis in various diagrams. The y-axis scale determines the vertical resolution of the measurement results.

The scale of the x-axis in the diagrams is fix. If you want to get a better resolution of the x-axis, you have to zoom into the diagram.

The remote commands required to configure the y-axis scale are described in Chapter 7.11.4, "Y-axis scale", on page 237.

Manual scaling of the y-axis
The "Y Minimum" and "Y Maximum" properties define a custom scale of the y-axis.

The "Y Minimum" corresponds to the value at the origin. The "Y Maximum" corresponds to the last value on the y-axis. The scale you select applies to the currently active window.

You can restore the original scale anytime with "Restore Scale".

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum
on page 238
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
on page 238

Automatic scaling of the y-axis
Usually, the best way to view the results is if they fit ideally in the diagram area and display the complete trace. The "Auto Scale Once" automatically determines the scale of the y-axis that fits this criteria in the currently active window.

Tip: You can also scale the windows in the "Auto Set" menu. In addition to scaling the selected window ("Auto Scale Window"), you can change the scale of all windows at the same time ("Auto Scale All").

You can restore the original scale anytime with "Restore Scale".

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 237

6.1.4 Zoom

The zoom feature allows you to zoom into any graphical result display. This can be a useful tool if you want to analyze certain parts of a diagram in more detail.

The zoom functionality is the same as in the spectrum application.

The following zoom functions are supported.

- : Magnifies the selected diagram area.
- : Magnifies the selected diagram area, but keeps the original diagram in a separate window.
- : Restores the original diagram.

Note that the zoom is a graphical feature that magnifies the data in the capture buffer. Zooming into the diagram does not reevaluate the I/Q data.

For a comprehensive description of the zoom, refer to the R&S FSV/A user manual.

6.1.5 Markers

Access: "Overview" > "Analysis" > "Marker"

Markers are a tool that help you to identify measurement results at specific trace points. When you turn on a marker, it gives you the coordinates of its position, for example the frequency and its level value or the symbol and its EVM value.

In general, the marker functionality of setting and positioning markers is similar to the spectrum application.

For I/Q measurement, the R&S FSV/A supports up to four markers, for frequency sweep measurements there are more. Markers give either absolute values (normal markers) or values relative to the first marker (deltamarkers). If a result display has more than one trace, for example the "EVM vs Symbol" result display, you can position the marker on either trace. By default, all markers are positioned on trace 1.

Note that if you analyze more than one bandwidth part, each bandwidth part is represented by a different trace.

The R&S FSV/A also supports several automatic positioning mechanisms that allow you to move the marker to the maximum trace value (peak), the minimum trace value or move it from peak to subsequent peak.

The marker table summarizes the marker characteristics.

For a comprehensive description, refer to the R&S FSV/A user manual.

Markers in result displays with a third quantity

In result displays that show a third quantity, for example the "EVM vs Symbol x Carrier" result, the R&S FSV/A provides an extended marker functionality.

You can position the marker on a specific resource element, whose position is defined by the following coordinates:

- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

Alternatively, you can define the marker position in the "Marker Configuration" dialog box, which is expanded accordingly.

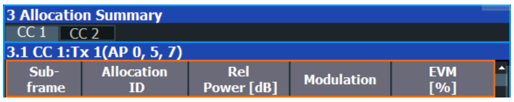
The marker information shows the EVM, the power and the allocation ID of the resource element you have selected as the marker position.

6.2 Analysis tools for I/Q measurements

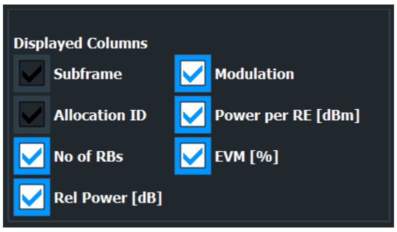
6.2.1 Layout of numerical results

You can customize the displayed information of some numerical result displays or tables, for example the allocation summary.

► Select some point in the header row of the table.



The application opens a dialog box to add or remove columns.

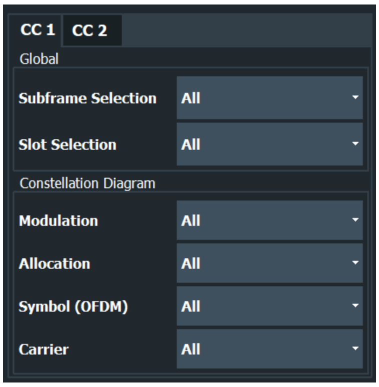


Add and remove columns as required.

6.2.2 Evaluation range

Access: "Overview" > "Evaluation Range"

The evaluation range defines the signal parts that are considered during signal analysis.



Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

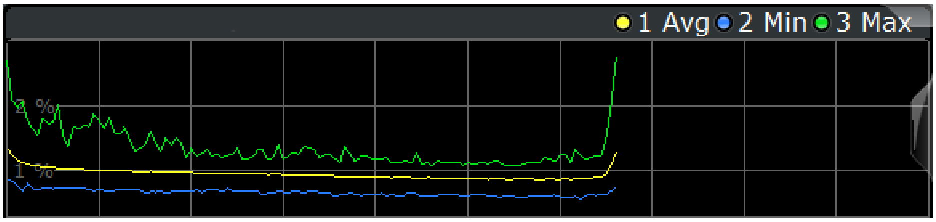
When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

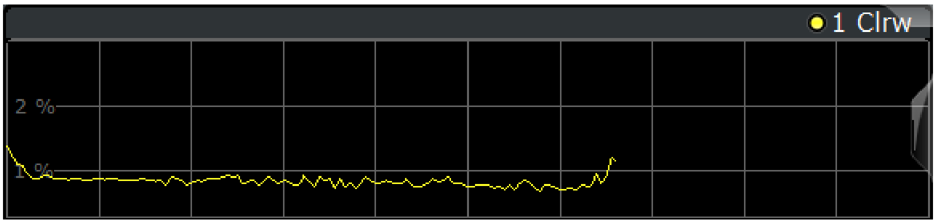
Subframe Selection
The "Subframe" selection filters the results by a specific subframe number.

If you apply the filter, only the results for the subframe you have selected are displayed. Otherwise, the R&S FSV/A shows the results for all subframes that have been analyzed.

The R&S FSV/A shows three traces if you display the results for all subframes.
- One trace ("Min") shows the minimum values measured over all analyzed subframes.
- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.



If you filter by a single subframe, the R&S FSV/A still shows three traces, but with different information.
- One trace ("Min") shows the minimum values measured over all slots in the selected subframe.
- One trace ("Max") shows the maximum values measured over all slots in the selected subframe.
- One trace ("Avg") shows the average values measured over all slots in the selected subframe.
  The number of traces is only reduced to one trace if you filter by a single slot.



In PRACH analysis mode, you cannot filter by a single subframe.

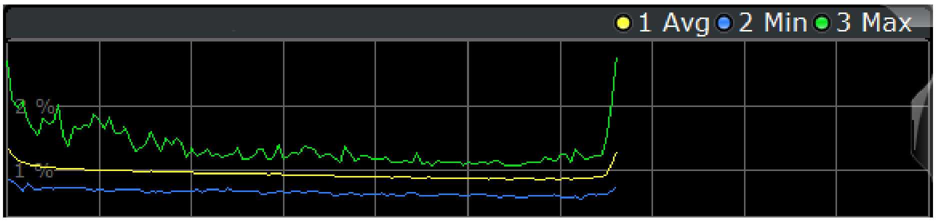
You can apply the filter to the following result displays.
- Result Summary
- EVM vs Carrier / EVM vs Symbol / EVM vs Symbol X Carrier
- Spectrum Flatness / Spectrum Flatness SRS / Spectrum Flatness Difference
- Inband Emission
- Group Delay
- Power vs Symbol X Carrier
- Constellation Diagram
- DFT Precoded Constellation
- Allocation Summary
- Bit Stream
- Time Alignment Error

Remote command:
[SENSe:][LTE:][CC<cc>:]SUBFrame:SELect on page 236

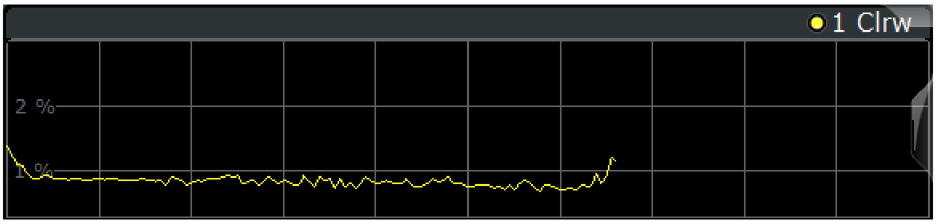
Slot Selection
The "Slot" selection filters the results by a specific slot number.

If you apply the filter, only the results for the slot you have selected are displayed. Otherwise, the R&S FSV/A shows the results for all slots.

The R&S FSV/A shows three traces if you display the results for all slots.
- One trace ("Min") shows the minimum values measured over all slots.
- One trace ("Max") shows the maximum values measured over all slots.
- One trace ("Avg") shows the average values measured over all slots.



If you filter by a single slot, the R&S FSV/A shows one trace that represents the values measured for that slot only.



In PRACH analysis mode, you cannot filter by a single slot.

You can apply the filter to the following result displays.
- Result Summary
- EVM vs Carrier / EVM vs Symbol / EVM vs Symbol X Carrier
- Inband Emission
- Spectrum Flatness / Spectrum Flatness Difference
- Group Delay
- Power vs Symbol X Carrier
- Constellation Diagram

Remote command:
[SENSe:][LTE:][CC<cc>:]SLOT:SELect on page 236

Preamble Selection
The "Preamble" selection filters the results by a specific preamble.

The R&S FSV/A shows three traces if you display the results for all preambles.
- One trace ("Min") shows the minimum values measured over all preambles.
- One trace ("Max") shows the maximum values measured over all preambles.
- One trace ("Avg") shows the average values measured over all preambles.

If you filter by a single preamble, the R&S FSV/A shows one trace that represents the values measured for that preamble only.

Remote command:
[SENSe:][LTE:][CC<cc>:]PREamble:SELect on page 235

Evaluation range for the constellation diagram
The "Evaluation Range" for the constellation diagram selects the information displayed in the constellation diagram.

By default, the constellation diagram contains the constellation points of the complete data that has been analyzed. However, you can filter the results by several aspects.

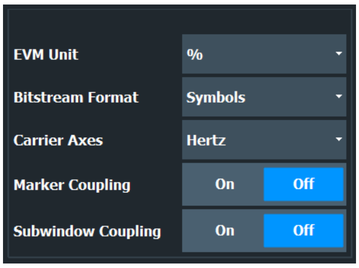
- Modulation
  Filters the results by the selected type of modulation.
- Allocation
  Filters the results by a certain type of allocation.
- Symbol (OFDM)
  Filters the results by a certain OFDM symbol.
- Carrier
  Filters the results by a certain subcarrier.

Remote command:
Modulation: [SENSe:][LTE:][CC<cc>:]MODulation:SELect on page 235
Allocation: [SENSe:][LTE:][CC<cc>:]ALLocation:SELect on page 234
Symbol: [SENSe:][LTE:][CC<cc>:]SYMBol:SELect on page 237
Carrier: [SENSe:][LTE:][CC<cc>:]CARRier:SELect on page 235

6.2.3 Result settings

Access: "Overview" > "Analysis" > "Result Settings"

Result settings define the way certain measurement results are displayed.



EVM Unit
The "EVM Unit" selects the unit for the EVM measurement results in diagrams and numerical result displays.

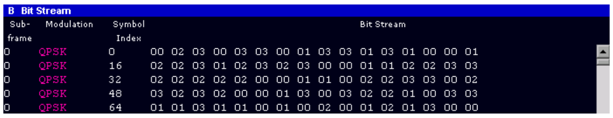
Possible units are dB and %.

Remote command:
UNIT:EVM on page 240

Bit Stream Format
Selects the way the bit stream is displayed.

The bit stream is either a stream of raw bits or of symbols. In case of the symbol format, the bits that belong to a symbol are shown as hexadecimal numbers with two digits.

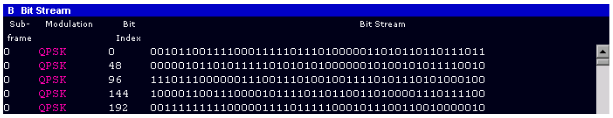
Example:



B Bit Stream

Sub-frame	Modulation	Symbol Index	Bit Stream
0	QPSK	0	00 02 03 00 03 03 00 01 03 03 01 03 01 00 00 01
0	QPSK	16	02 02 03 01 02 03 02 03 00 00 01 01 02 02 03 03
0	QPSK	32	02 02 02 02 02 00 00 01 01 00 02 02 03 03 00 02
0	QPSK	48	03 02 03 02 00 00 01 03 00 03 02 02 01 00 03 03
0	QPSK	64	01 01 03 01 01 00 01 00 02 00 01 02 01 03 00 00

Figure 6-1: Bit stream display in uplink application if the bit stream format is set to "symbols"



B Bit Stream

Sub-frame	Modulation	Bit Index	Bit Stream
0	QPSK	0	001011001111000111110111010000011010110110111011
0	QPSK	48	000001011010111110101010100000001010010101110010
0	QPSK	96	111011100000011100111010010011110101110101000100
0	QPSK	144	100001100111000010111101101100110100001110111100
0	QPSK	192	001111111111000001111011111000101110011001000001 0

Figure 6-2: Bit stream display in uplink application if the bit stream format is set to "bits"

Remote command:
UNIT:BSTR on page 239

Carrier Axes
The "Carrier Axes" selects the unit of the x-axis in result displays that show results over the subcarriers.

- "Hertz"
  X-axis shows the results in terms of the subcarrier frequency.
- "Subcarrier Number"
  X-axis shows the results in terms of the subcarrier number.

Remote command:
UNIT:CAXes on page 240

Marker Coupling
Couples or decouples markers that are active in multiple result displays.

When you turn on this feature, the application moves the marker to its new position in all active result displays.

When you turn it off, you can move the markers in different result displays independent from each other.

Remote command:
CALCulate<n>:MARKer<m>:COUPling on page 239

Subwindow Coupling
Couples or decouples result display tabs (subwindows).

If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays.

Subwindow coupling is available for measurements with multiple data streams (for example carrier aggregation).

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling` on page 239

6.3 Analysis tools for frequency sweep measurements

Access: "Overview" > "Analysis"

Access: "Overview" > "Analysis"

The analysis tools available for the frequency sweep measurements are the same as in the spectrum analyzer.

For more information, refer to the R&S FSV/A user manual.

7 Remote control

The following remote control commands are required to configure and perform LTE measurements in a remote environment. The R&S FSV/A must already be set up for remote operation in a network as described in the base unit manual.

Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S FSV/A User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers (specific status registers for Pulse measurements are not used).

SCPI Recorder - automating tasks with remote command scripts

The LTE measurement application also supports the SCPI Recorder functionality.

Using the SCPI Recorder functions, you can create a SCPI script directly on the instrument and then export the script for use on the controller. You can also edit or write a script manually, using a suitable editor on the controller. For manual creation, the instrument supports you by showing the corresponding command syntax for the current setting value.

For details see the "Network and Remote Operation" chapter in the R&S FSV/A User Manual.

7.1 Common suffixes

In the LTE measurement application, the following common suffixes are used in remote commands:

Table 7-1: Common suffixes used in remote commands in the LTE measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line
<al>	0..110	Selects a subframe allocation.
<in>	1..4	Selects an instrument for MIMO measurements.
<ant>	1..4	Selects an antenna for MIMO measurements.
<cc>	1..5	Selects a component carrier. The actual number of supported component carriers depends on the selected measurement
<cluster>	1..2	Selects a cluster (uplink only).
<cw>	1..n	Selects a codeword.
<k>	---	Selects a limit line. Irrelevant for the LTE application.
<sf>	DL: 0..49 UL: 0..9	Selects a subframe.

7.2 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S FSV/A.

Remote command examples

Note that some remote command examples mentioned in this general introduction are possibly not supported by this particular application.

7.2.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value, and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S FSV/A follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

7.2.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:

`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

7.2.3 Numeric suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

7.2.4 Optional keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

If an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

7.2.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

7.2.6 SCPI parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, they are separated by a comma.

Example:

`LAYout:ADD:WINDow Spectrum,LEFT,MTABle`

Parameters can have different forms of values.

7.2.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

With unit: `SENSe:FREQuency:CENTer 1GHZ`

Without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. for discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.
- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN
  Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

7.2.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "`ON`" or the numeric value 1. The "off" state (logically untrue) is represented by "`OFF`" or the numeric value 0.

Querying Boolean parameters

When you query Boolean parameters, the system returns either the value 1 ("`ON`") or the value 0 ("`OFF`").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return `1`

7.2.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 7.2.2, "Long and short form", on page 111.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

7.2.6.4 Character strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELete 'Spectrum'`

7.2.6.5 Block data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

7.3 Status register

The LTE measurement application uses the standard status registers of the R&S FSV/A (depending on the measurement type). However, some registers are used differently. Only those differences are described in the following sections.

For details on the common R&S FSV/A status registers refer to the description of remote control basics in the R&S FSV/A user manual.

*RST does not influence the status registers.

STATus:QUEStionable:SYNC register

The `STATus:QUEStionable:SYNC` register contains application-specific information. If any errors occur in this register, the status bit #11 in the `STATus:QUEStionable` register is set to 1.

Each active channel uses a separate `STATus:QUEStionable:SYNC` register. Thus, if the status bit #11 in the `STATus:QUEStionable` register indicates an error, the error may have occurred in any of the channel-specific `STATus:QUEStionable:SYNC` registers. In this case, you must check the register of each channel to determine which channel caused the error. By default, querying the status of a register always returns the result for the currently selected channel. However, you can specify any other channel name as a query parameter.

Table 7-2: Meaning of the bits used in the STATus:QUEStionable:SYNC register

Bit No.	Meaning
0	Configured frame not found
1	Sync not found

Bit No.	Meaning
2 to 5	Unused
6	Auto level no signal
7	Setting mismatch
8	Signal analysis error
9 to 14	Unused
15	This bit is always 0

7.4 LTE application selection

INSTrument:CREate:DUPLicate

Duplicates the currently selected channel, i.e creates a new channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

Example:
```
INST:SEL 'IQAnalyzer'
INST:CRE:DUPL
```
Duplicates the channel named 'IQAnalyzer' and creates a new channel named 'IQAnalyzer2'.

Usage: Event

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

Adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 117.

<ChannelName> String containing the name of the channel.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

Example: `INST:CRE SAN, 'Spectrum 2'`
Adds a spectrum display named "Spectrum 2".

INSTrument:CREate:REPLace <ChannelName1>, <ChannelType>, <ChannelName2>

Replaces a channel with another one.

Setting parameters:

<ChannelName1> String containing the name of the channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types, see `INSTrument:LIST?` on page 117.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see `INSTrument:LIST?` on page 117).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:CRE:REPL 'IQAnalyzer2',IQ,'IQAnalyzer'`
Replaces the channel named "IQAnalyzer2" by a new channel of type "IQ Analyzer" named "IQAnalyzer".

Usage: Setting only

INSTrument:DELete <ChannelName>

Deletes a channel.

Setting parameters:

<ChannelName> String containing the name of the channel you want to delete.
A channel must exist to delete it.

Usage: Setting only

INSTrument:LIST?

Queries all active channels. The query is useful to obtain the names of the existing channels, which are required to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see tables below).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 3 channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','IQ','IQ Analyzer2'`

Usage: Query only

Table 7-3: Available channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
5G NR (R&S FSV3-K144)	NR5G	5G NR
3GPP FDD BTS (R&S FSV3-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSV3-K73)	MWCD	3G FDD UE
Amplifier Measurements (R&S FSV3-K18)	AMPLifier	Amplifier
AM/FM/PM Modulation Analysis	ADEM	Analog Demod
Bluetooth (R&S FSV3-K8)	BTO	Bluetooth
GSM (R&S FSV3-K10)	GSM	GSM
I/Q Analyzer	IQ	IQ Analyzer
LTE (R&S FSV3-K10x)	LTE	LTE
NB-IoT (R&S FSV3-K106)	NIOT	NB-IoT
Noise Figure Measurements	NOISE	Noise
OFDM VSA (R&S FSV3-K96)	OFDMVSA	OFDM VSA
Phase Noise (R&S FSV3-K40)	PNOISE	Phase Noise
Pulse (R&S FSV3-K6)	PULSE	Pulse
Vector Signal Analysis (VSA, R&S FSV3-K70)	DDEM	VSA
WLAN (R&S FSV3-K91)	WLAN	WLAN
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:REName <ChannelName1>, <ChannelName2>

Renames a channel.

Setting parameters:
<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'IQAnalyzer2','IQAnalyzer3'`
Renames the channel with the name 'IQAnalyzer2' to 'IQAnalyzer3'.

Usage: Setting only

INSTrument[:SELect] <ChannelType>

Selects a new measurement channel with the defined channel type.

Parameters:
<ChannelType> **LTE**
LTE measurement channel

Example: //Select LTE application
`INST LTE`

7.5 Screen layout

7.5.1 General layout

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay:FORMat <Format>

Determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example: `DISP:FORM SPL`

DISPlay[:WINDow<n>]:SIZE <Size>

Maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 125).

Suffix:

<n> Window

Parameters:

<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Example: //Put the focus on window 1
`DISP:WIND1:SEL`

Example: //Put the focus on subwindow 2 in window 1
`DISP:WIND1:SUBW2:SEL`

DISPlay[:WINDow<n>]:TAB<tab>:SELect

Selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

Suffix:

<n> Window

<tab> 1..n
Tab

Example: //Select a tab
`DISP:WIND2:TAB2:SEL`

7.5.2 Layout of a single channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Note: Use this command to select a result display instead of `CALCulate:FEED` (still supported for compatibility reasons, but deprecated).

Query parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.
<Direction>	LEFT | RIGHt | ABOVe | BELow Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:	`LAY:ADD? '1',LEFT,MTAB`
	Result:
	`'2'`
	Adds a new window named '2' with a marker table to the left of window 1.

Usage:	Query only
Manual operation:	See "Capture Buffer" on page 16 See "EVM vs Carrier" on page 17 See "EVM vs Symbol" on page 18 See "EVM vs Subframe" on page 18 See "Power Spectrum" on page 19 See "Inband Emission" on page 19 See "Spectrum Flatness" on page 20 See "Spectrum Flatness SRS" on page 20 See "Group Delay" on page 21 See "Spectrum Flatness Difference" on page 21 See "Constellation Diagram" on page 22 See "CCDF" on page 22 See "Allocation Summary" on page 23 See "Bitstream" on page 23 See "EVM vs Symbol x Carrier" on page 25 See "Power vs Symbol x Carrier" on page 25 See "Marker Table" on page 28 See "Time Alignment Error" on page 30 See "Marker Peak List" on page 37

Table 7-4: <WindowType> parameter values for LTE uplink measurement application

Parameter value	Window type
I/Q measurements	
ASUM	"Allocation Summary"
BSTR	"Bitstream"
CBUF	"Capture Buffer"
CCDF	"CCDF"
CONS	"Constellation Diagram"
EVCA	"EVM vs. Carrier"
EVSU	"EVM vs. Subframe"
EVSY	"EVM vs. Symbol"
EVSC	"EVM vs. Symbol X Carrier"
GDEL	"Group Delay"
IE	"Inband Emission"
IEA	"Inband Emission All"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
PVSC	"Power vs. Symbol X Carrier"
RSUM	"Result Summary"
SFD	"Spectrum Flatness" Difference
SFL	"Spectrum Flatness"
SFSR	"Spectrum Flatness" SRS
Time alignment error	
CBUF	"Capture Buffer"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
TAL	"Time Alignment Error"
ACLR and **SEM** measurements	
DIAG	"Diagram"
PEAK	"Peak List"
MTAB	"Marker Table"
RSUM	"Result Summary"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 121 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

Changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command does not work, but does not return an error.

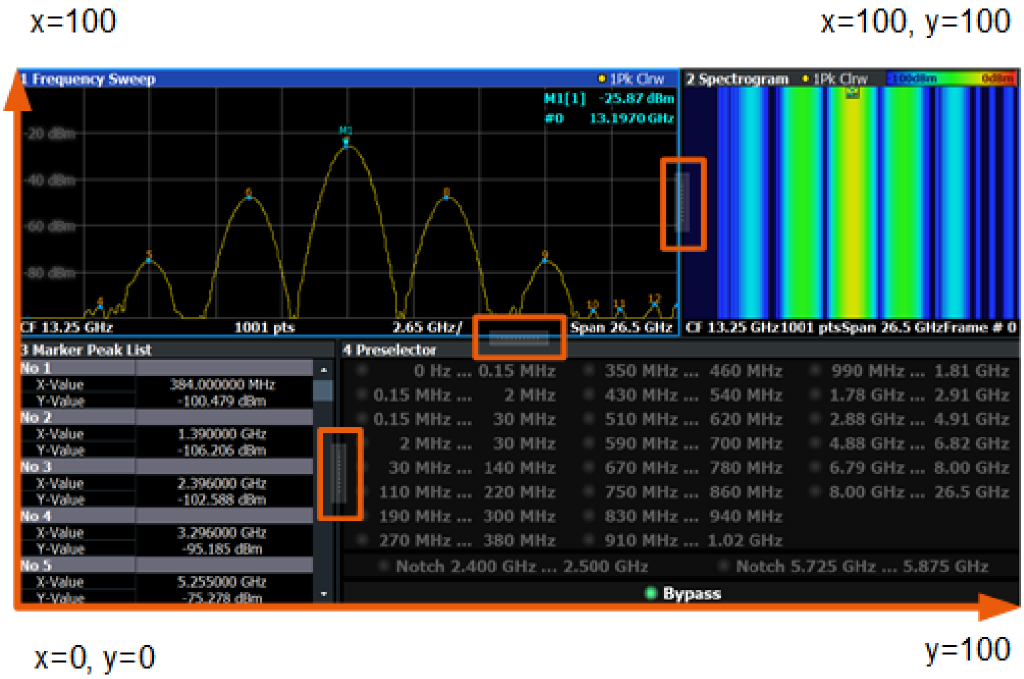


Figure 7-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 7-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.
Range: 0 to 100

Example:
```
LAY:SPL 1,3,50
```
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Table"') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: `LAY:SPL 1,4,70`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
`LAY:SPL 3,2,70`
`LAY:SPL 4,1,70`
`LAY:SPL 2,1,70`

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike `LAYout:ADD[:WINDow]?`, for which the existing window is defined by a parameter.

To replace an existing window, use the `LAYout:WINDow<n>:REPLace` command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 121 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: `LAY:WIND1:ADD? LEFT,MTAB`
Result:
`'2'`
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 121 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 121.

Note that this command is not available in all applications and measurements.

Suffix:

<n> 1..n
Window

Parameters:

<WindowType>

Example: `LAY:WIND2:TYPE?`

7.6 Measurement control

7.6.1 Measurements

ABORt

Aborts the measurement in the current channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC?` or `*WAI` command after `ABOR` and before the next command.

For details on overlapping execution see Remote control via SCPI.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S FSV/A is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSV/A on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`

Now you can send the `ABORt` command on the remote channel performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: Event

INITiate<n>:CONTinuous <State>

Controls the measurement mode for an individual channel.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 1 (some applications can differ)

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

INITiate<n>[:IMMediate]

Starts a (single) new measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see Remote control via SCPI.

Suffix:
<n> irrelevant

Usage: Asynchronous command

[SENSe:]SYNC[:CC<cc>][:STATe]?

Queries the current synchronization state.

Suffix:

<cc> irrelevant

Return values:

<State> The string contains the following information:
A zero represents a failure and a one represents a successful synchronization.

Example: //Query synchronization state
`SYNC:STAT?`
Would return, e.g. '1' for successful synchronization.

Usage: Query only

7.6.2 Measurement sequences

INITiate:SEQuencer:ABORt

Stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 131.

Usage: Event

INITiate:SEQuencer:IMMediate

Starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 132).

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using `*OPC`, `*OPC?` or `*WAI`, use `SINGle` Sequencer mode.

Parameters:

<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

SYSTem:SEQuencer <State>

Turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSV/A User Manual.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

```
SYST:SEQ ON
```
Activates the Sequencer.
```
INIT:SEQ:MODE SING
```
Sets single Sequencer mode so each active measurement is performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.
```
SYST:SEQ OFF
```

7.7 Trace data readout

7.7.1 The TRACe[:DATA] command

This chapter contains information on the `TRACe:DATA` command and a detailed description of the characteristics of that command.

The `TRACe:DATA` command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. In case of results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

Note also that return values for results that are available for both downlink and uplink may be different.

For several result displays, the command also supports various SCPI parameters in combination with the query. If available, each SCPI parameter returns a different aspect of the results. If SCPI parameters are supported, you have to quote one in the query.

Example:

```
TRAC2:DATA? TRACE1
```

The format of the return values is either in ASCII or binary characters and depends on the format you have set with `FORMat[:DATA]`.

Following this detailed description, you will find a short summary of the most important functions of the command (`TRACe<n>[:DATA]?`).

Selecting a measurement window

Before querying results, you have to select the measurement window with the suffix <n> at `TRACe`. The range of <n> depends on the number of active measurement windows.

On an R&S FSQ or R&S FSV, the suffix <n> was not supported. On these instruments, you had to select the measurement window with `DISPlay:WINDow<n>:SELect` first.

For measurements on aggregated carriers or multiple antennas, where each measurement window has subwindows, you have to select the subwindow first with `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

7.7.1.1 Adjacent channel leakage ratio

For the ACLR result display, the number and type of returns values depend on the parameter.

- `TRAC:DATA TRACE1`
  Returns one value for each trace point.

7.7.1.2 Allocation summary

For the allocation summary, the command returns several values for each line of the table.

- `<subframe>`
- `<allocation ID>`
- `<number of RB>`
- `<offset RB>`

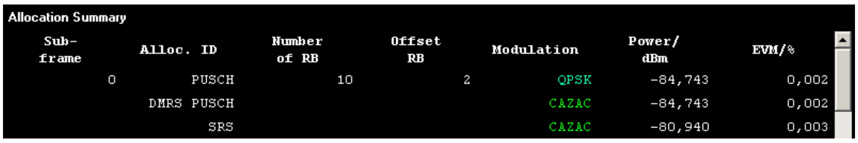
- <modulation>
- <absolute power>
- <EVM>

The data format of the return values is always ASCII.

The return values have the following characteristics.

- The <allocation ID is encoded.
  For the code assignment, see Chapter 7.7.1.20, "Return value codes", on page 142.
- The <modulation> is encoded.
  For the code assignment, see Chapter 7.7.1.20, "Return value codes", on page 142.
- The unit for <absolute power> is always dBm.
- The unit for <EVM> depends on UNIT:EVM.

Example:



Allocation Summary

Sub-frame	Alloc. ID	Number of RB	Offset RB	Modulation	Power/ dBm	EVM/%
0	PUSCH	10	2	QPSK	-84,743	0,002
	DMRS PUSCH			CAZAC	-84,743	0,002
	SRS			CAZAC	-80,940	0,003

TRAC:DATA? TRACE1 would return:

```
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
0, -42, 0, 0, 6, -80.9404231343884, 3.97834623871343E-06,
...
```

Additional information "ALL"

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

```
//For subframe 0:
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//For subframe 1:
1, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
1, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

7.7.1.3 Bit stream

For the bitstream result display, the number of return values depends on the parameter.

- `TRACE:DATA TRACE1`
  Returns several values and the bitstream for each line of the table.
  `<subframe>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...`
- `TRACE:DATA TRACE2`
  Returns all informative values of an allocation, including the totals over all PUSCH allocations that contribute to the bitstream, but not the bitstream itself.
  `<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...,<total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>`
- `TRACE:DATA TRACE3`
  Returns all informative values of an allocation, including the totals over all PUSCH allocations that contribute to the bitstream, but not the bitstream itself. The difference to `TRACE2` is that this query also includes the Bit/s result.
  `<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...,<total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>, <bits/second>`

All values have no unit. The format of the bit stream depends on Bit Stream Format.

The `<modulation>` is encoded. For the code assignment see Chapter 7.7.1.20, "Return value codes", on page 142.

For symbols or bits that are not transmitted, the command returns

- "FFF" if the bit stream format is "Symbols"
- "9" if the bit stream format is "Bits".

For symbols or bits that could not be decoded because the number of layer exceeds the number of receive antennas, the command returns

- "FFE" if the bit stream format is "Symbols"
- "8" if the bit stream format is "Bits".

Note that the data format of the return values is always ASCII.

Example:

Bit Stream

Sub-frame	Allocation ID	Code-word	Modulation	Symbol Index	Bit Stream
0	PUSCH	1/1	QPSK	0	03 01 02 03 03 00 00 00 01 02 02 01 02 01 00 00
0	PUSCH	1/1	QPSK	16	00 03 03 03 02 02 01 00 03 01 02 03 03 03 03 01
0	PUSCH	1/1	QPSK	32	03 03 00 00 03 01 02 00 01 00 02 00 02 00 00 03

`TRAC:DATA? TRACE1` would return:

```
0, -40, 0, 2, 0, 03, 01, 02, 03, 03, 00, 00, 00, 01, 02, 02, ...
<continues like this until the next data block starts or the end of data is reached>
0, -40, 0, 2, 32, 03, 03, 00, 00, 03, 01, 02, 00, 01, 00, ...
```

7.7.1.4 Capture buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

`<absolute power>, ...`

The unit is always dBm.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Note that the command returns positive peak values only.

7.7.1.5 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- `TRAC:DATA TRACE1`
  Returns the probability values (y-axis).
  `<# of values>, <probability>, ...`
  The unit is always %.
  The first value that is returned is the number of the following values.
- `TRAC:DATA TRACE2`
  Returns the corresponding power levels (x-axis).
  `<# of values>, <relative power>, ...`
  The unit is always dB.
  The first value that is returned is the number of the following values.

7.7.1.6 Channel and spectrum flatness

For the channel flatness result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Returns the average power over all subframes.
- `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.7 Channel and spectrum flatness difference

For the channel flatness difference result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.
- `TRAC:DATA TRACE1`
  Returns the average power over all subframes.
- `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.8 Channel flatness SRS

For the channel flatness SRS result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB.

The following parameters are supported.
- `TRAC:DATA TRACE1`
  Returns the average power over all subframes.
- `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.9 Group delay

For the group delay result display, the command returns one value for each trace point.

`<group delay>, ...`

The unit is always ns. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average group delay over all subframes.
- `TRAC:DATA TRACE2`
  Returns the minimum group delay found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum group delay found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.10 Constellation diagram

For the constellation diagram, the command returns two values for each constellation point.

<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,

<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,

<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,

<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,

<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,

<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns all constellation points included in the selection.
- `TRAC:DATA TRACE2`
  Returns the constellation points of the reference symbols included in the selection.
- `TRAC:DATA TRACE3`
  Returns the constellation points of the SRS included in the selection.

7.7.1.11 EVM vs carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average EVM over all subframes
- `TRAC:DATA TRACE2`
  Returns the minimum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.7.1.12 EVM vs subframe

For the EVM vs subframe result display, the command returns one value for each subframe that has been analyzed.

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.7.1.13 EVM vs symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

`<EVM>, ...`

For measurements on a single subframe, the command returns the symbols of that subframe only.

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.7.1.14 EVM vs symbol x carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

```
<EVM[Symbol(0),Carrier(1)]>, ..., <EVM[Symbol(0),Carrier(n)]>,
<EVM[Symbol(1),Carrier(1)]>, ..., <EVM[Symbol(1),Carrier(n)]>,
...
<EVM[Symbol(n),Carrier(1)]>, ..., <EVM[Symbol(n),Carrier(n)]>,
```

The unit depends on UNIT:EVM.

Resource elements that are unused return NAN.

The following parameters are supported.

- TRAC:DATA TRACE1

7.7.1.15 Frequency error vs symbol

For the frequency error vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

<frequency error>,...

The unit is always Hz.

The following parameters are supported.

- TRAC:DATA TRACE1

7.7.1.16 Inband emission

For the inband emission result display, the number and type of returns values depend on the parameter.

- TRAC:DATA TRACE1
  Returns the relative resource block indices (x-axis values).
  <RB index>, ...
  The resource block index has no unit.
- TRAC:DATA TRACE2
  Returns one value for each resource block index.
  <relative power>, ...
  The unit of the relative inband emission is dB.
- TRAC:DATA TRACE3
  Returns the data points of the upper limit line.
  <limit>, ...
  The unit is always dB.

Note that you have to select a particular subframe to get results.

7.7.1.17 Power spectrum

For the power spectrum result display, the command returns one value for each trace point.

<power>,...

The unit is always dBm/Hz.

The following parameters are supported.

- TRAC:DATA TRACE1

7.7.1.18 Power vs symbol x carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

`<P[Symbol(0),Carrier(1)]>, ..., <P[Symbol(0),Carrier(n)]>,`

`<P[Symbol(1),Carrier(1)]>, ..., <P[Symbol(1),Carrier(n)]>,`

`...`

`<P[Symbol(n),Carrier(1)]>, ..., <P[Symbol(n),Carrier(n)]>,`

with P = Power of a resource element.

The unit is always dBm.

Resource elements that are unused return `NAN`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.7.1.19 Spectrum emission mask

For the SEM measurement, the number and type of returns values depend on the parameter.

- `TRAC:DATA TRACE1`
  Returns one value for each trace point.
  `<absolute power>, ...`
  The unit is always dBm.
- `TRAC:DATA LIST`
  Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.
  `<index>, <start frequency in Hz>, <stop frequency in Hz>, <RBW in Hz>, <limit fail frequency in Hz>, <absolute power in dBm>, <relative power in dBc>, <limit distance in dB>, <limit check result>, <reserved>, <reserved>...`
  The `<limit check result>` is either a 0 (for PASS) or a 1 (for FAIL).

7.7.1.20 Return value codes

<number of symbols or bits>

In hexadecimal mode, this represents the number of symbols to be transmitted. In binary mode, it represents the number of bits to be transmitted.

<allocation ID>

Represents the allocation ID. The value is a number in the range {1...-70}.

- **1** = Reference symbol
- **0** = Data symbol

- **-1** = Invalid
- **-40** = PUSCH
- **-41** = DMRS PUSCH
- **-42** = SRS PUSCH
- **-50** = PUCCH
- **-51** = DMRS PUCCH
- **-70** = PRACH

<channel type>

- **0** = TX channel
- **1** = adjacent channel
- **2** = alternate channel

<codeword>

Represents the codeword of an allocation. The range is {0...6}.

- **0** = 1/1
- **1** = 1/2
- **2** = 2/2
- **3** = 1/4
- **4** = 2/4
- **5** = 3/4
- **6** = 4/4

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **5** = 8PSK
- **6** = CAZAC
- **7** = mixed modulation
- **8** = BPSK
- **14** = 256QAM

FORMat[:DATA] <Format>

Selects the data format for the data transmission between the R&S FSV/A and the remote client.

Parameters:

<Format> ASCii | REAL

*RST: ASCii

Example: //Select data format
`FORM REAL`

TRACe<n>[:DATA]? <Result>

This command queries the trace data for each measurement point (y-axis values).

In combination with `TRACe<n>[:DATA]:X?`, you can thus query the coordinates of each measurement point.

Suffix:

<n> Window

Query parameters:

<TraceNumber> **TRACE1 | TRACE2 | TRACE3**
Queries the trace data of the corresponding trace.

LIST Queries the results for the SEM measurement.

Return values:

<TraceData> For more information about the type of return values in the different result displays, see Chapter 7.7.1, "The TRACe[:DATA] command", on page 133.

Example: //Query results of the second measurement window. The type of data that is returned by the parameter (`TRACE1`) depends on the result display shown in measurement window 2.
`TRAC2? TRACE1`

Usage: Query only

Manual operation: See "Data import and export" on page 100

TRACe<n>[:DATA]:X? <Result>

Queries the horizontal trace data for each measurement point (x-axis values).

In combination with `TRACe<n>[:DATA]?`, you can thus query the coordinates of each measurement point.

Suffix:

<n> Window

Query parameters:

<TraceNumber> TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Return values:

<TraceData> The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

Example: //Query trace data of trace 1 in window 2

```
TRAC2? TRACE1
TRAC2:X? TRACE1
```

Usage: Query only

Manual operation:
See "Capture Buffer" on page 16
See "EVM vs Carrier" on page 17
See "EVM vs Symbol" on page 18
See "EVM vs Subframe" on page 18
See "Power Spectrum" on page 19
See "Inband Emission" on page 19
See "Spectrum Flatness" on page 20
See "Spectrum Flatness SRS" on page 20
See "Group Delay" on page 21
See "Spectrum Flatness Difference" on page 21

7.7.2 Result readout

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESult[:CURRent]? [<Measurement>]

Queries the results of the ACLR measurement or the total signal power level of the SEM measurement.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single sweeps.

Suffix:

<n> Window

<m> Marker

<sb> irrelevant

Query parameters:

<Measurement>

CPOW
This parameter queries the channel power of the reference range.

MCAC
Queries the channel powers of the ACLR, MC ACLR and Cumulative ACLR measurements as shown in the ACLR table.
Where available, this parameter also queries the power of the adjacent channels (for example in the ACLR measurement).

GACLr
Queries the ACLR values for each gap channel in the MC ACLR measurement.

Return values:

<Result>

Results for the Spectrum Emission Mask measurement:
Power level in dBm.

Results for the ACLR measurements:
Relative power levels of the ACLR channels. The number of return values depends on the number of transmission and adjacent channels. The order of return values is:
• <TXChannelPower> is the power of the transmission channel in dBm
• <LowerAdjChannelPower> is the relative power of the lower adjacent channel in dB
• <UpperAdjChannelPower> is the relative power of the upper adjacent channel in dB
• <1stLowerAltChannelPower> is the relative power of the first lower alternate channel in dB
• <1stUpperAltChannelPower> is the relative power of the first lower alternate channel in dB
(...)
• <nthLowerAltChannelPower> is the relative power of a subsequent lower alternate channel in dB
• <nthUpperAltChannelPower> is the relative power of a subsequent lower alternate channel in dB

Example:

```
CALC1:MARK:FUNC:POW:RES? MCAC
```

Returns the current ACLR measurement results.

Usage: Query only

Manual operation: See "Result summary" on page 33
See "Result summary" on page 36

7.8 Numeric result readout

7.8.1 Frame results

FETCh[:CC<cc>]:SUMMary:EVM:SDQP[:AVERage]?

Queries the EVM of all DMRS PUSCH resource elements with QPSK modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:SDQP?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:SDSF[:AVERage]?

Queries the EVM of all DMRS PUSCH resource elements with 64QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:SDSF?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:SDST[:AVERage]?

Queries the EVM of all DMRS PUSCH resource elements with 16QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:SDST?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:SDTS[:AVERage]?

Queries the EVM of all DMRS PUSCH resource elements with 256QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:DSTS?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:UCCD[:AVERage]?

Queries the EVM of all DMRS PUCCH resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:UCCD?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:UCCH[:AVERage]?

Queries the EVM of all PUCCH resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:UCCH?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:UPRA[:AVERage]?

Queries the EVM of all PRACH resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:UPRA?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USQP[:AVERage]?

Queries the EVM of all PUSCH resource elements with QPSK modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USQP?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USSF[:AVERage]?

Queries the EVM of all PUSCH resource elements with 64QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>
EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USSF?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USST[:AVERage]?

Queries the EVM of all PUSCH resource elements with 16QAM modulation.

Suffix:
<cc> Component Carrier

Return values:
<EVM> EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USST?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:USTS[:AVERage]?

Suffix:

<cc> Component Carrier

Return values:

<EVM> <numeric value>

EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:USTS?`

Usage: Query only

7.8.2 Result for selection

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?

Queries the average crest factor as shown in the result summary.

Suffix:
<cc> Component Carrier

Return values:
<CrestFactor> <numeric value>

Crest Factor in dB.

Example: //Query crest factor
`FETC:SUMM:CRES?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?

Queries the EVM of all resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>

Minimum, maximum or average EVM, depending on the last command syntax element.
The unit is % or dB, depending on your selection.

Example: //Query EVM
`FETC:SUMM:EVM?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?

Queries the EVM of all physical channel resource elements.

Suffix:
<cc> Component Carrier

Return values:
<EVM> <numeric value>

EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
`FETC:SUMM:EVM:PCH?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?

Queries the EVM of all physical signal resource elements.

Suffix:

<cc> Component Carrier

Return values:

<EVM> <numeric value>

Minimum, maximum or average EVM, depending on the last command syntax element.
The unit is % or dB, depending on your selection.

Example: //Query EVM
`FETC:SUMM:EVM:PSIG?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?

Queries the frequency error.

Suffix:

<cc> Component Carrier

Return values:

<FrequencyError> <numeric value>

Minimum, maximum or average frequency error, depending on the last command syntax element.

Default unit: Hz

Example: //Query average frequency error
`FETC:SUMM:FERR?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:GIMBalance:MAXimum?
FETCh[:CC<cc>]:SUMMary:GIMBalance:MINimum?
FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]?

Queries the I/Q gain imbalance.

Suffix:

<cc> Component Carrier

Return values:

<GainImbalance> <numeric value>

Minimum, maximum or average I/Q imbalance, depending on the last command syntax element.

Default unit: dB

Example: //Query average gain imbalance
`FETC:SUMM:GIMB?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:IQOFfset:MAXimum?
FETCh[:CC<cc>]:SUMMary:IQOFfset:MINimum?
FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?

Queries the I/Q offset.

Suffix:

<cc> Component Carrier

Return values:

<IQOffset> <numeric value>

Minimum, maximum or average I/Q offset, depending on the last command syntax element.

Default unit: dB

Example: //Query average IQ offset
`FETC:SUMM:IQOF?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?
FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?

Queries the total power.

Suffix:

<cc> Component Carrier

Return values:

<Power> <numeric value>

Minimum, maximum or average power, depending on the last command syntax element.

Default unit: dBm

Example: //Query average total power
`FETC:SUMM:POW?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:QUADerror:MAXimum?
FETCh[:CC<cc>]:SUMMary:QUADerror:MINimum?
FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]?

Queries the quadrature error.

Suffix:

<cc> Component Carrier

Return values:

<QuadratureError> <numeric value>

Minimum, maximum or average quadrature error, depending on the last command syntax element.

Default unit: deg

Example: //Query average quadrature error
`FETC:SUMM:QUAD?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?

Queries the sampling error.

Suffix:

<cc> Component Carrier

Return values:

<SamplingError> <numeric value>

Minimum, maximum or average sampling error, depending on the last command syntax element.

Default unit: ppm

Example: //Query average sampling error
`FETC:SUMM:SERR?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:TFRame?

Queries the (sub)frame start offset as shown in the capture buffer.

Note that you have to select a particular subframe; otherwise the command returns an error.

Suffix:

<cc> Component Carrier

Return values:

<Offset> Time difference between the (sub)frame start and capture buffer start.

Default unit: s

Example: //Query subframe start offset
`FETC:SUMM:TFR?`

Usage: Query only

Manual operation: See "Capture Buffer" on page 16

7.8.3 Time alignment error

FETCh:FEPPm[:CC<cc>]:MAXimum?
FETCh:FEPPm[:CC<cc>]:MINimum?
FETCh:FEPPm[:CC<cc>][:AVERage]?

Queries the carrier frequency error.

Suffix:
<cc> Component Carrier

Return values:
<FrequencyError> Average, minimum or maximum frequency error, depending on the command syntax.
Default unit: ppm

Example: //Query frequency error
`FETC:FERR:MAX?`

Usage: Query only

Manual operation: See "Carrier Frequency Error" on page 31

FETCh:FERRor[:CC<cc>]:MAXimum?
FETCh:FERRor[:CC<cc>]:MINimum?
FETCh:FERRor[:CC<cc>][:AVERage]?

Queries the carrier frequency error.

Suffix:
<cc> Component Carrier

Return values:

<FrequencyError> <numeric value>

Average, minimum or maximum frequency error, depending on the command syntax.

Default unit: Hz

Example: //Query frequency error.
`FETC:FERR?`

Usage: Query only

Manual operation: See "Carrier Frequency Error" on page 31

FETCh:TAERror[:CC<cc>]:ANTenna<antenna>:MAXimum
FETCh:TAERror[:CC<cc>]:ANTenna<antenna>:MINimum
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?

Queries the time alignment error.

Suffix:

<cc> Component Carrier

<ant> Antenna

Return values:

<TAE> Minimum, maximum or average time alignment error, depending on the last command syntax element.

Default unit: s

Example: //Query average TAE between reference antenna and antenna 2
`FETC:TAER:ANT2?`

Usage: Query only

Manual operation: See "Time Alignment Error" on page 30

7.8.4 Marker table

CALCulate<n>:DELTamarker<m>:X <Position>

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n>	Window
<m>	Marker

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

Queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 130.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Result> <numeric value>

Result at the deltamarker position. The return value is a value relative to the position of marker 1.
The type of value and its unit depend on the selected result display.

Example: //Query coordinates of deltamarker 2 in window 4
`CALC4:DELT2:X?`
`CALC4:DELT2:Y?`

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit depends on the result display.
Range: The range depends on the current x-axis range.
Default unit: Hz

Example:
```
CALC:MARK2:X 1.7MHz
```
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 28
See "Marker Peak List" on page 37

CALCulate<n>:MARKer<m>:Y <Result>

Queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 130.

Suffix:

<n> Window

<m> Marker
Note that 3D diagrams only support one marker.

Parameters:

<Result> <numeric value>
Result at the marker position.
The type of value and its unit depend on the selected result display.

Example:
//Query coordinates of marker 2 in window 4
```
CALC4:MARK2:X?
CALC4:MARK2:Y?
```

Example:
//Define position of marker in 3D diagram
```
CALC:MARK:X 16
CALC:MARK:Y 6
```

Manual operation: See "Marker Table" on page 28
See "Marker Peak List" on page 37

CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Returns the type of value displayed in the selected result display (EVM or Power).

Suffix:

<n> Window

<m> Marker

Return values:

<Position> <numeric value>

Default unit: Depends on result display

Example: //Query marker position
`CALC:MARK:Z?`

Usage: Query only

Manual operation: See "Marker Table" on page 28

CALCulate<n>:MARKer<m>:Z:ALL?

Queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM **or** Power), which is possible with `CALCulate<n>:MARKer<m>:Z?`, this command returns all types of values (EVM **and** Power), regardless of the result display type.

Suffix:

<n> Window

<m> irrelevant

Return values:

<Position> <numeric value>

EVM
EVM at the marker position.

Power
Power at the marker position.

Modulation
Modulation type at the marker position.

Example: //Query EVM and Power at the marker position.
`CALC:MARK:Z:ALL?`

Usage: Query only

Manual operation: See "Marker Table" on page 28

7.8.5 CCDF table

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

Queries the results of the CCDF.

Suffix:

<n> Window

<t> Trace

Query parameters:

<Probability>

P0_01
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Return values:

<CCDF Result>

Example: `CALC:STAT:CCDF:X1? P10`
Returns the level values that are over 10 % above the mean value.

Usage: Query only

Manual operation: See "CCDF" on page 22

CALCulate<n>:STATistics:RESult<res>? <ResultType>

Queries the results of a measurement for a specific trace.

Suffix:

<n> Window

<res> Trace

Query parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example:
`CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "CCDF" on page 22

7.9 Limit check result readout

7.9.1 Limits for graphical result displays

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult? [<Result>]

Queries the limit check results for the adjacent channels during ACLR measurements.

Suffix:
<n> irrelevant

 irrelevant

Query parameters:
<Result> **REL**
Queries the channel power limit check results.

ABS
Queries the distance to the limit line.

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES?`

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES? ABS`

Usage: Query only

Manual operation: See "Result summary" on page 36

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:ABSolute

Queries the absolute limit check results for adjacent channels (ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n> irrelevant

 irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES:ABS?`

CALCulate<n>:LIMit<li>:ACPower:ACHannel:RESult:RELative

Queries the relative limit check results for the adjacent channels (ACLR measurements).

Prerequisites for this command

- Select relative limit check mode

ACLR: CALCulate<n>:LIMit<li>:ACPower:PMODe.

Suffix:

<n> irrelevant

 irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the adjacent channel limit check
`CALC:LIM:ACP:ACH:RES:REL?`

CALCulate<n>:LIMit<li>:ACPower:ALTernate<alt>:RESult? [<Result>]

Queries the limit check results for the alternate channels during ACLR measurements.

Suffix:

<n> irrelevant

 irrelevant

<alt> irrelevant

Query parameters:

<Result> **REL**
Queries the channel power limit check results.

ABS
Queries the distance to the limit line.

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower alternate channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ALT:RES?`

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ACH:RES? ABS`

Usage: Query only

Manual operation: See "Result summary" on page 36

CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:ABSolute

Queries the absolute limit check results for the alternate channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<ch>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ALT:RES:ABS?`

CALCulate<n>:LIMit<li>:ACPower:ALTernate<ch>:RESult:RELative

Queries the relative limit check results for the alternate channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<ch>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the alternate channel limit check
`CALC:LIM:ACP:ALT:RES:REL?`

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult?

Queries the ACLR power limit check results for the gap channels (MC ACLR measurements).

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:ABSolute?

Queries the absolute power limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES:ABS?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>:ACLR:RESult:RELative?

Queries the relative power limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:ACLR:RES:REL?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult?

Queries the limit check results for the gap channels (MC ACLR measurements).

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:ABSolute?

Queries the absolute limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select absolute limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:RES:ABS?`

Usage: Query only

CALCulate<n>:LIMit<li>:ACPower:GAP<gap>[:CACLr]:RESult:RELative?

Queries the relative limit check results for the gap channels (MC ACLR measurements).

Prerequisites for this command

- Select relative limit check mode
  evaluation mode
  ACLR: `CALCulate<n>:LIMit<li>:ACPower:PMODe`.

Suffix:

<n>	irrelevant
	irrelevant
<gap>	irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent channel.

PASSED
Limit check has passed.

FAILED
Limit check has failed.

Example: //Query results of the gap channel limit check
`CALC:LIM:ACP:GAP:RES:REL?`

Usage: Query only

CALCulate<n>:LIMit<li>:FAIL?

Queries the limit check results for all measurements that feature a limit check.

Suffix:

<n> irrelevant

 irrelevant

Return values:

<LimitCheck> Returns two values, one for the upper and one for the lower adjacent or alternate channel.

0
Limit check has passed.

1
Limit check has failed.

Example: //Query the limit check in the active result display
`CALC:LIM:FAIL?`

Usage: Query only

7.9.2 Limits for numerical result display

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]:RESult?

Queries the results of the EVM limit check of all resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
`CALC:LIM:SUMM:EVM:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]:RESult?

Queries the results of the EVM limit check of all physical channel resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query physical channel limit check result
`CALC:LIM:SUMM:EVM:PCH:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]:RESult?

Queries the results of the EVM limit check of all physical signal resource elements.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query physical signal limit check result
`CALC:LIM:SUMM:EVM:PSIG:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:SDQP[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH DMRS resource elements with a QPSK modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:SDQP:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:SDSF[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH DMRS resource elements with a 64QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> **FAILED**
Limit check has failed.
PASSED
Limit check has passed.
NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
`CALC:LIM:SUMM:EVM:SDSF:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:SDST[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH DMRS resource elements with a 16QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> **FAILED**
Limit check has failed.
PASSED
Limit check has passed.
NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:SDST:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:SDTS[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH DMRS resource elements with a 256QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:SDTS:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:UCCD[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUCCH DMRS resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:UCCD:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:UCCH[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUCCH resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:UCCH:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:UPRA[:AVERage]:RESult?

Queries the results of the EVM limit check of all PRACH resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
`CALC:LIM:SUMM:EVM:UPRA:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:USQP[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH resource elements with a QPSK modulation

Suffix:

<n>	irrelevant
	irrelevant

<cc> Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
`CALC:LIM:SUMM:EVM:USQP:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:USSF[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH resource elements with a 64QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:USSF:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:USST[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH resource elements with a 16QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:USST:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:USTS[:AVERage]:RESult?

Queries the results of the EVM limit check of all PUSCH resource elements with a 256QAM modulation.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck>

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check result
`CALC:LIM:SUMM:EVM:USTS:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:FERRor:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:FERRor[:AVERage]:RESult?

Queries the result of the frequency error limit check.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query frequency error limit check result
`CALC:LIM:SUMM:SERR:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:GIMBalance:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:GIMBalance[:AVERage]:RESult?

Queries the result of the gain imbalance limit check.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query gain imbalance limit check result
`CALC:LIM:SUMM:GIMB:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:IQOFfset:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:IQOFfset[:AVERage]:RESult?

Queries the result of the I/Q offset limit check.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query I/Q offset limit check result
`CALC:LIM:SUMM:IQOF:MAX:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:QUADerror:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:QUADerror[:AVERage]:RESult?

Queries the result of the quadrature error limit check.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query quadrature error limit check results
`CALC:LIM:SUMM:QUAD:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:SERRor:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:SERRor[:AVERage]:RESult?

Queries the results of the sampling error limit check.

Suffix:

<n> irrelevant

 irrelevant

<cc> Component Carrier

Return values:

<LimitCheck> The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query sample error limit check result
`CALC:LIM:SUMM:SERR:RES?`

Usage: Query only

7.10 Configuration

7.10.1 General configuration

The following remote control command control general configration of the application.

The remote control commands to select the result displays for I/Q measurements are described in Chapter 7.5, "Screen layout", on page 119.

CONFigure[:LTE]:MEASurement <Measurement>

Selects the measurement.

Parameters:
<Measurement>

ACLR
Selects the Adjacent Channel Leakage Ratio measurement.

ESPectrum
Selects the Spectrum Emission Mask measurement.

EVM
Selects I/Q measurements.

MCACIr
Selects Multi-Carrier ACLR measurement.

MCESpectrum
Selects Multi-Carrier SEM measurement.

TAERor
Selects the Time Alignment Error measurement.

TPOO
Selects the Transmit On/Off Power measurement.

*RST: EVM

Example: //Select measurement
`CONF:MEAS EVM`

Manual operation: See "EVM" on page 13
See "Time alignment error" on page 14
See "Channel power ACLR" on page 14
See "SEM" on page 14
See "Adjacent Channel Leakage Ratio (ACLR)" on page 32
See "Spectrum Emission Mask (SEM)" on page 34
See "Multi Carrier ACLR (MC ACLR)" on page 35
See "Select Measurement" on page 51

FORMat:DEXPort:FORMat <FileFormat>

Determines the format of the ASCII file to be imported or exported. Depending on the external program that creates the data file or evaluates it, a comma-separated list (CSV) or a plain data format (DAT) file is required.

Parameters:

<FileFormat> CSV | DAT
*RST: DAT

Example: `FORM:DEXP:FORM CSV`

Manual operation: See "Data import and export" on page 100

MMEMory:STORe<n>:IQ:STATe <Value>,<FileName>

Saves I/Q data to a file.

Suffix:

<n> irrelevant

Parameters:

<Value> 1

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:IQ:STAT 'C:\R_S\Instr\user\data.iq.tar'`
Saves I/Q data to the specified file.

Manual operation: See "Data import and export" on page 100

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

Example: `INST:SEL 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 51

7.10.2 I/Q measurements

7.10.2.1 Signal description

Signal characteristics

CONFigure[:LTE]:DUPLexing <Duplexing>

Selects the duplexing mode.

Parameters:

<Duplexing>

TDD
Time division duplex

FDD
Frequency division duplex

*RST: FDD

Example: //Select time division duplex
`CONF:DUPL TDD`

Manual operation: See "Selecting the LTE mode" on page 53

CONFigure[:LTE]:LDIRection <Direction>

Selects the link direction.

Parameters:

<Direction>

DL
Selects the mode to analyze downlink signals.

UL
Selects the mode to analyze uplink signals.

Example: //Select downlink mode
`CONF:LDIR DL`

Manual operation: See "Selecting the LTE mode" on page 53

CONFigure[:LTE]:UL[:CC<cc>]:BW <Bandwidth>

Selects the channel bandwidth.

Suffix:

<cc> Component Carrier

Parameters:

<Bandwidth> BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00

Example: //Select bandwidth for single carrier measurement
`CONF:UL:BW BW1_40`

Example: //Select bandwidth for first component carrier
`CONF:UL:CC1:BW BW20_00`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56
See "Channel Bandwidth / Number of Resource Blocks" on page 56

CONFigure[:LTE]:UL[:CC<cc>]:CYCPrefix <PrefixLength>

Selects the cyclic prefix.

Suffix:

<cc> Component Carrier

Parameters:

<PrefixLength>

NORM
Normal cyclic prefix length

EXT
Extended cyclic prefix length

AUTO
Automatic cyclic prefix length detection

*RST: AUTO

Example:
//Single carrier measurements:
//Select extended cyclic prefix
`CONF:UL:CYCP EXT`

Example:
//Aggregated carrier measurements:
//Select extended cyclic prefix for the first carrier
`CONF:UL:CC1:CYCP EXT`

Manual operation: See "Cyclic Prefix" on page 57

CONFigure[:LTE]:UL[:CC<cc>]:PLC:CID <CellID>

Defines the cell ID.

Suffix:

<cc> Component Carrier

Parameters:

<CellID>

AUTO
Automatically determines the cell ID.

<numeric value> (integer only)
Number of the cell ID.

Range: 0 to 503

Example:
//Select automatic detection of the cell ID
`CONF:UL:PLC:CID AUTO`

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

CONFigure[:LTE]:UL[:CC<cc>]:PLC:CIDGroup <GroupNumber>

Selects the cell identity group.

Suffix:

<cc> Component Carrier

Parameters:

<GroupNumber> <numeric value> (integer only)

Range: 1 to 167
*RST: 0

Example: //Select cell identity group 12
`CONF:UL:PLCI:CIDG 12`

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

CONFigure[:LTE]:UL[:CC<cc>]:PLC:PLID <Identity>

Selects the physical layer identity.

Suffix:

<cc> Component Carrier

Parameters:

<Identity> 0 | 1 | 2

Example: //Select physical layer identity 2
`CONF:DL:PLC:PLID 2`

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

CONFigure[:LTE]:UL[:CC<cc>]:TDD:SPSC <Configuration>

Selects the special TDD subframe configuration.

Suffix:

<cc> Component Carrier

Parameters:

<Configuration> <numeric value>

Example: //Single carrier measurements:
//Select special subframe configuration
`CONF:UL:TDD:SPSC 2`

Example: //Carrier aggregation measurements:
//Selects special subframe configuration for the first carrier.
`CONF:UL:CC1:TDD:SPSC 2`

Manual operation: See "Conf. of Special Subframe" on page 58

CONFigure[:LTE]:UL[:CC<cc>]:TDD:UDConf <Configuration>

Selects the subframe configuration for TDD signals.

Suffix:

<cc> Component Carrier

Parameters:

<Configuration> <numeric value>

Range: 0 to 6
*RST: 0

Example: //Single carrier measurements:
//Selects allocation configuration number
`CONF:UL:TDD:UDC 4`

Example: //Carrier aggregation measurements:
//Select allocation configuration number 4 for the first carrier
`CONF:UL:CC1:TDD:UDC 4`

Manual operation: See "TDD UL/DL Allocations" on page 57

FETCh[:CC<cc>]:CYCPrefix?

Queries the cyclic prefix type that has been detected.

Suffix:

<cc>

Return values:

<PrefixType> The command returns -1 if no valid result has been detected yet.

NORM
Normal cyclic prefix length detected

EXT
Extended cyclic prefix length detected

Example: //Query current cyclic prefix length type
`FETC:CYCP?`

Usage: Query only

FETCh[:CC<cc>]:PLC:CIDGroup?

Queries the cell identity group that has been detected.

Suffix:

<cc> Component Carrier

Return values:

<CIDGroup> The command returns -1 if no valid result has been detected yet.

Range: 0 to 167

Example: //Query the current cell identity group
`FETC:PLC:CIDG?`

Usage: Query only

FETCh[:CC<cc>]:PLC:PLID?

Queries the cell identity that has been detected.

Suffix:
<cc> Component Carrier

Return values:
<Identity> The command returns -1 if no valid result has been detected yet.
Range: 0 to 2

Example: //Query the current cell identity
`FETC:PLC:PLID?`

Usage: Query only

MMEMory:LOAD[:CC<cc>]:DEModsetting <File>

Restores previously saved demodulation settings.

The file must be of type `.allocation` and depends on the link direction that was currently selected when the file was saved. You can load only files with correct link directions.

Suffix:
<cc> Component Carrier

Parameters:
<File> String containing the path and name of the file.

Example: //Load allocation file
`MMEM:LOAD:DEM 'D:\USER\Settingsfile.allocation'`

Manual operation: See "User defined test scenarios" on page 60

MMEMory:STORe<n>[:CC<cc>]:DEModsetting <FileName>

Saves the signal description.

Suffix:
<n> irrelevant

<cc> irrelevant

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.allocation`.

Example: //Save signal description
`MMEM:STOR:DEM 'c:\TestSignal.allocation'`

Manual operation: See "User defined test scenarios" on page 60

MMEMory:LOAD[:CC<cc>]:TMOD:UL <TestModel>

Loads an O-RAN test case.

Suffix:
<cc> Component Carrier

Parameters:

<TestModel> **<string>**
String that contains the name of the O-RAN test case, e.g. `'TC 3.2.3.7.1'`.

Example: //Select O-RAN test case
`MMEM:LOAD:TMOD:DL 'TC 3.2.3.7.1'`

Manual operation: See "ORAN test cases" on page 59

[SENSe:][LTE:][CC<cc>:]SFLatness:ECONditions <State>

Turns extreme conditions for spectrum flatness measurements on and off.

Suffix:

<cc> Component Carrier

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on extreme conditions
`SFL:ECON ON`

Manual operation: See "Extreme Conditions" on page 59

[SENSe:][LTE:][CC<cc>:]SFLatness:OBANd <Subbands>

Selects the operating band for spectrum flatness measurements.

Suffix:

<cc> Component Carrier

Parameters:

<Subbands> <numeric value> (integer only)
Range: 1 to 40
*RST: 1

Example: //Select operating band 10
`SFL:OBAN 10`

Manual operation: See "Operating Band Index" on page 59

[SENSe:][LTE:]UL:DEMod:LOFRequency <Frequency>

Defines the LO frequency when its location is not at the center of the channel bandwidth.

Prerequisites for this command

- Turn on custom LO location (`[SENSe:][LTE:]UL:DEMod:LOLocation`).

Parameters:

<Frequency> <numeric value>

Default unit: Hz

Example: //Define LO frequency

`UL:DEM:LOL USER`

`UL:DEM:LOFR 850MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56

[SENSe:][LTE:]UL:DEMod:LOLocation <Location>

Selects the location of the local oscillator in a system with contiguous aggregated carriers.

Parameters:

<Location>

CACB
LO is at the center of the aggregated channel bandwidth.

CCC
One LO is at the center of each component carrier.

USER
One LO is used for all component carriers. The frequency is not necessarily at the center of the aggregated channel bandwidth. You can define the LO frequency with .

*RST: CABC

Example: //Use an LO for each component carrier.

`UL:DEM:LOL CCC`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56

MIMO configuration

CONFigure[:LTE]:UL[:CC<cc>]:MIMO:ASELection <Antenna>

Selects the antenna for measurements with MIMO setups.

In case of Time Alignment measurements, the command selects the reference antenna.

Suffix:

<cc> Component Carrier

Parameters:

<Antenna>

ANT1 | ANT2 | ANT3 | ANT4
Select a single antenna to be analyzed

ALL
Select all antennas to be analyzed

Example: //Select antenna to be analyzed
`CONF:UL:MIMO:ASEL ANT2`

Manual operation: See "MIMO Configuration" on page 61

Subframe configuration

CONFigure[:LTE]:UL[:CC<cc>]:CSUBframes <Subframes>

Selects the number of configurable subframes in the uplink signal.

Suffix:
<cc> Component Carrier

Parameters:
<Subframes> Range: 1 to 10
*RST: 1

Example: //Define number of configurable subframes
`CONF:UL:CSUB 5`

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:CONT <AllocationContent>

Allocates a PUCCH or PUSCH to an uplink allocation.

Suffix:
<cc> Component Carrier

<sf> Subframe

Parameters:
<AllocationContent>

NONE
Turns off the PUSCH and the PUCCH.

PUCCh
Turns on the PUCCH.

PUSCh
Turns on the PUSCH.

PSCC
Turns on the PUCCH as well as the PUSCH.

*RST: PUSCh

Example: //Assign PUCCH allocation to a subframe
`CONF:UL:SUBF8:ALL:CONT PUCC`

Manual operation: See "Enable PUCCH" on page 64
See "Enable PUSCH" on page 64

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:MODulation <Modulation>

Selects the modulation of an uplink allocation.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Modulation> QPSK | QAM16 | QAM64 | QAM256

*RST: QPSK

Example: //Define modulation of the allocation in subframe 8
`CONF:UL:SUBF8:ALL:MOD QPSK`

Manual operation: See "Modulation" on page 64

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PRECoding:CBINdex <CodebookIndex>

Selects the codebook index for a PUSCH allocation.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<CodebookIndex> Range: 0 to 5
*RST: 0

Example: //Select codebook index for PUSCH allocation
`CONF:UL:SUBF:ALL:PREC:CBIN 1`

Manual operation: See "Enhanced PUSCH Configuration" on page 65

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PRECoding:CLMapping <Mapping>

Selects the codeword to layer mapping for a PUSCH allocation.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:
<Mapping> LC11 | LC21 | LC22

Example: //Assign codeword-to-layer mapping to subframe 2
`CONF:UL:SUBF2:ALL:PREC:CLM LC11`

Manual operation: See "Enhanced PUSCH Configuration" on page 65

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUCCh:FORMat <Format>

Selects the PUCCH format for a specific subframe.

The command is available if you have selected PUCCH format selection on subframe basis with `CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:FORMat`.

Suffix:
<cc> Component Carrier

<sf> Subframe

Parameters:
<Format> **F1 (F1)**

F1A (F1a)

F1B (F1b)

F2 (F2)

F2A (F2a)

F2B (F2b)

F3 (F3)

Example: //Select PUCCH format in subframe 4
`CONF:UL:SUBF4:ALL:PUCC:FORM F3`

Manual operation: See "Enhanced PUCCH Configuration" on page 66

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUCCh:NPAR <Configuration>

Defines N_PUCCH on a subframe basis.

The command is available if `CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:NPAR` on page 205 is turned on.

Suffix:
<cc> Component Carrier

<sf> Subframe

Parameters:
<Configuration> <numeric value>

Example: //Select N_PUCCH
`CONF:UL:SUBF:ALL:PUCC:NPAR 2`

Manual operation: See "Enhanced PUCCH Configuration" on page 66

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUSCh:CSField <CyclicShiftField>

Defines the cyclic shift field of the demodulation reference signal.

Available if `CONFigure[:LTE]:UL[:CC<cc>]:DRS:AOCC` on page 194 has been turned on.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<CyclicShiftField> Range: 0 to 7
*RST: 0

Example: //Define cyclic shift field
`CONF:UL:SUBF:ALL:PUSC:CSF 4`

Manual operation: See "Enhanced Demodulation Reference Signal Configuration" on page 66

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:PUSCh:NDMRs <Value>

Defines the part of the DMRS index that is used for the uplink scheduling assignment.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<Value> <numeric value>
Range: 0 to 11
*RST: 0

Example: //Defines DMRS index
`CONF:UL:SUBF:ALL:PUSC:NDMR 2`

Manual operation: See "Enhanced Demodulation Reference Signal Configuration" on page 66

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc:RATO <State>

Turns the resource allocation type 1 on and off.

Suffix:

<cc> Component Carrier

<sf> Subframe

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on resource allocation type 1
`CONF:UL:SUBF:ALL:RATO ON`

Manual operation: See "Enhanced PUSCH Configuration" on page 65

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc[:CLUSter<cl>]:RBCount <ResourceBlocks>

Selects the number of resource blocks in an uplink subframe.

Suffix:

<cc> Component Carrier

<sf> Subframe

<cl> Cluster

Parameters:

<ResourceBlocks> <numeric value>

*RST: 11

Example: //Select number of resource blocks for subframe 8
`CONF:UL:SUBF8:ALL:RBC 8`

Manual operation: See "Number of RB" on page 65

CONFigure[:LTE]:UL[:CC<cc>]:SUBFrame<sf>:ALLoc[:CLUSter<cl>]:RBOFfset <Offset>

Defines the resource block offset in an uplink subframe.

Suffix:

<cc> Component Carrier

<sf> Subframe

<cl> Cluster

Parameters:

<Offset> <numeric value>

*RST: 2

Example: //Define resource block offset
`CONF:UL:SUBF8:ALL:RBOF 5`

Manual operation: See "Offset RB" on page 65

[SENSe:][LTE:]UL:DEMod:ACON <Type>

Selects the method of automatic demodulation.

Parameters:

<Type> **ALL**
Automatically detects and demodulates the PUSCH and SRS.

OFF
Automatic demodulation is off.

SCON
Automatically detects and demodulates the values available in the subframe configuration table.

Example: //Turn off automatic demodulation off
`UL:DEM:ACON OFF`

Manual operation: See "Auto Demodulation" on page 62

[SENSe:][LTE:]UL:FORMat:SCD <State>

Turns detection of the subframe configuration on and off.

Prerequisites for this command

- Turn off auto demodulation `[SENSe:][LTE:]UL:DEMod:ACON`

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on automatic subframe configuration
`UL:FORM:SCD ON`

Manual operation: See "Subframe Configuration Detection" on page 63

Global settings

CONFigure[:LTE]:UL[:CC<cc>]:SFNO <Offset>

Defines the system frame number offset.

The application uses the offset to demodulate the frame.

Suffix:

<cc> Component Carrier

Parameters:

<Offset> <numeric value> (integer only)

*RST: 0

Example: //Select frame number offset
`CONF:UL:SFNO 2`

Manual operation: See "Frame Number Offset" on page 67

CONFigure[:LTE]:UL[:CC<cc>]:UEID <ID>

Defines the radio network temporary identifier (RNTI) of the UE.

Suffix:
<cc> Component Carrier

Parameters:
<ID> <numeric value> (integer only)

Range: 0 to 65535
*RST: 0

Example: //Define a RNTI of 2
`CONF:UL:UEID 2`

Manual operation: See "UE ID/n_RNTI" on page 68

Demodulation reference signal

CONFigure[:LTE]:UL[:CC<cc>]:DRS:AOCC <State>

Turns the configuration of the demodulation reference signal on a subframe basis via the "Cyclic Field Shift" on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF

Example: //Turn on Activate-DMRS-with OCC
`CONF:UL:DRS:AOCC ON`

Manual operation: See "Activate-DMRS-With OCC" on page 70

CONFigure[:LTE]:UL[:CC<cc>]:DRS:DSSHift <Shift>

Selects the delta sequence shift of the uplink signal.

Suffix:
<cc> Component Carrier

Parameters:
<Shift> <numeric value> (integer only)
*RST: 0

Example: //Select delta sequence shift
`CONF:UL:DRS:DSSH 3`

Manual operation: See " Delta Sequence Shift" on page 70

CONFigure[:LTE]:UL[:CC<cc>]:DRS:GRPHopping <State>

Turns group hopping for uplink signals on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on group hopping
`CONF:UL:DRS:GRPH ON`

Manual operation: See " Group Hopping" on page 69

CONFigure[:LTE]:UL[:CC<cc>]:DRS:NDMRs <Value>

Defines the n_{DMRS}.

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value>

Example: //Select n_{DMRS} 0.
`CONF:UL:DRS:NDMR 0`

Manual operation: See " n(1)_DMRS" on page 69

CONFigure[:LTE]:UL[:CC<cc>]:DRS:PLID <Identity>

Defines the (cell) identity of the demodulation reference signal (DRS).

Suffix:
<cc> Component Carrier

Parameters:
<Identity> **FCID**
From Cell ID: Uses the common identity defined with `CONFigure[:LTE]:UL[:CC<cc>]:PLC:PLID` on page 183.

<numeric value>
Custom Identity for the DRS (range: 1...2).

*RST: FCID

Example: //Select identity of DRS
`CONF:UL:DRS:PLID FCID`

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

CONFigure[:LTE]:UL[:CC<cc>]:DRS:PUCCh:POWer <Power>

Sets the relative power of the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define power of the PUCCH
`CONF:UL:DRS:PUCC:POW 2`

Manual operation: See " Relative Power PUCCH" on page 69

CONFigure[:LTE]:UL[:CC<cc>]:DRS[:PUSCh]:POWer <Power>

Sets the relative power of the PUSCH.

Suffix:
<cc> Component Carrier

Parameters:
<Power> <numeric value>
*RST: 0
Default unit: dB

Example: //Define power of the PUSCH
`CONF:UL:DRS:POW 2`

Manual operation: See " Relative Power PUSCH" on page 69

CONFigure[:LTE]:UL[:CC<cc>]:DRS:SEQHopping <State>

Turns sequence hopping for uplink signals on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on sequence hopping
`CONF:UL:DRS:SEQH ON`

Manual operation: See " Sequence Hopping" on page 69

Sounding reference signal

CONFigure[:LTE]:UL[:CC<cc>]:SRS:ANST <State>

Turns simultaneous transmission of the sounding reference signal (SRS) and ACK/NACK messages (via PUCCH) on and off.

Simultaneous transmission works only if the PUCCH format ist either 1, 1a, 1b or 3.

Suffix:
<cc> Component Carrier

Parameters:
<State>

ON
Allows simultaneous transmission of SRS and PUCCH.

OFF
SRS not transmitted in the subframe for which you have configured simultaneous transmission of PUCCH and SRS.

Example: //Turn on simultaneous transmission of the SRS and PUCCH in one subframe

```
CONF:UL:SRS:ANST ON
```

Manual operation: See "A/N + SRS Simultaneous TX" on page 73

CONFigure[:LTE]:UL[:CC<cc>]:SRS:BHOP <Bandwidth>

Defines the frequency hopping bandwidth b_{hop}.

Suffix:
<cc> Component Carrier

Parameters:
<Bandwidth> <numeric value>

*RST: 0

Example: //Define frequency hopping bandwidth

```
CONF:UL:SRS:BHOP 1
```

Manual operation: See " Hopping BW b_hop" on page 72

CONFigure[:LTE]:UL[:CC<cc>]:SRS:BSRS <Bandwidth>

Defines the bandwidth of the SRS (B_{SRS}).

Suffix:
<cc> Component Carrier

Parameters:
<Bandwidth> <numeric value>
*RST: 0

Example: //Select SRS bandwidth
`CONF:UL:SRS:BSRS 1`

Manual operation: See " SRS Bandwidth B_SRS" on page 71

CONFigure[:LTE]:UL[:CC<cc>]:SRS:CSRS <Configuration>

Defines the SRS bandwidth configuration (C_{SRS}).

Suffix:
<cc> Component Carrier

Parameters:
<Configuration> <numeric value>
*RST: 0

Example: //Select SRS bandwidth configuration
`CONF:UL:SRS:CSRS 2`

Manual operation: See " SRS BW Conf. C_SRS" on page 72

CONFigure[:LTE]:UL[:CC<cc>]:SRS:CYCS <CyclicShift>

Sets the cyclic shift n_CS used for the generation of the sounding reference signal CAZAC sequence.

Suffix:
<cc> Component Carrier

Parameters:
<CyclicShift> <numeric value>
*RST: 0

Example: //Select cyclic shift
`CONF:UL:SRS:CYCS 2`

Manual operation: See " SRS Cyclic Shift N_CS" on page 72

CONFigure[:LTE]:UL[:CC<cc>]:SRS:ISRS <Index>

Defines the SRS configuration index (I_{SRS}).

Suffix:
<cc> Component Carrier

Parameters:
<Index> <numeric value>
*RST: 0

Example: //Select configuration index
`CONF:UL:SRS:ISRS 1`

Manual operation: See " Conf. Index I_SRS" on page 73

CONFigure[:LTE]:UL[:CC<cc>]:SRS:MUPT <State>

Turns SRS MaxUpPts on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on MaxUpPts
`CONF:UL:SRS:MUPT ON`

Manual operation: See "SRS MaxUpPts" on page 71

CONFigure[:LTE]:UL[:CC<cc>]:SRS:NRRC <Value>

Defines the UE-specific parameter frequency domain position n_{RRC}.

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value>
*RST: 0

Example: //Select n_{RRC}
`CONF:UL:SRS:NRRC 1`

Manual operation: See " Freq. Domain Pos. n_RRC" on page 73

CONFigure[:LTE]:UL[:CC<cc>]:SRS:POWer <Power>

Defines the relative power of the sounding reference signal.

Suffix:
<cc> Component Carrier

Parameters:

<Power> <numeric value>

*RST: 0

Example: //Define the power of sounding reference signal
`CONF:UL:SRS:POW -1.2`

Manual operation: See " SRS Rel Power" on page 72

CONFigure[:LTE]:UL[:CC<cc>]:SRS:STAT <State>

Turns the sounding reference signal on and off.

Suffix:

<cc> Component Carrier

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on the sounding reference signal
`CONF:UL:SRS:STAT ON`

Manual operation: See " Present" on page 71

CONFigure[:LTE]:UL[:CC<cc>]:SRS:SUConfig <Configuration>

Defines the SRS subframe configuration.

Prerequisites for this command

- Turn on the sounding reference signal with `CONFigure[:LTE]:UL[:CC<cc>]:SRS:STAT`.

Suffix:

<cc> Component Carrier

Parameters:

<Configuration> <numeric value> (integer only)

Range: 0 to 14
*RST: 0

Example: //Select SRS subframe configuration 4
`CONF:UL:SRS:SUC 4`

Manual operation: See " SRS Subframe Configuration" on page 71

CONFigure[:LTE]:UL[:CC<cc>]:SRS:TRComb <Value>

Defines the transmission comb (k_{TC}).

Suffix:

<cc> Component Carrier

Parameters:

<Value> <numeric value>

*RST: 0

Example: //Define transmission comb
`CONF:UL:SRS:TRC 1`

Manual operation: See " Transm. Comb. k_TC" on page 73

PUSCH structure

CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHMode <HoppingMode>

Selects the frequency hopping mode in the PUSCH structure.

Suffix:

<cc> Component Carrier

Parameters:

<HoppingMode> **NONE**
No hopping

INTer
Inter subframe hopping

INTRa
Intra subframe hopping

*RST: NONE

Example: //Turn off frequency hopping for PUSCH
`CONF:UL:PUSC:FHM NONE`

Manual operation: See " Frequency Hopping Mode" on page 74

CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHOFfset <Offset>

Defines the frequency hopping offset for the PUSCH.

Suffix:

<cc> Component Carrier

Parameters:

<Offset> <numeric value>

*RST: 4

Example: //Define a hopping offset
`CONF:UL:PUSC:FHOF 5`

Manual operation: See " PUSCH Hopping Offset" on page 75

CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:FHOP:IIHB <HBInfo>

Defines the information in hopping bits of the PUSCH.

Suffix:
<cc> Component Carrier

Parameters:
<HBInfo> <numeric value>

Range: 0 to 3
*RST: 0

Example: //Select information in hopping bits
```
CONF:UL:PUSC:FHOP:IIHB 1
```

Manual operation: See " Info. in Hopping Bits" on page 75

CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:NOSM <NoOfSubbands>

Defines the number of subbands/M of the PUSCH.

Suffix:
<cc> Component Carrier

Parameters:
<NoOfSubbands> <numeric value>

*RST: 4

Example: //Select number of subbands
```
CONF:UL:PUSC:NOSM 2
```

Manual operation: See " Number of Subbands" on page 75

CONFigure[:LTE]:UL[:CC<cc>]:PUSCh:PLID <Identity>

Defines the (cell) identity of the PUSCH.

Suffix:
<cc> Component Carrier

Parameters:
<Identity> **FCID**
From cell ID: Uses the common Identity defined with `CONFigure[:LTE]:UL[:CC<cc>]:PLC:PLID` on page 183.

<numeric value>
Custom identity for the PUCCH (range: 1...2).

*RST: FCID

Example: //Select PUSCH identity
```
CONF:UL:PUSC:PLID 0
```

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

PUCCH structure

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:DESHift <Shift>

Defines the delta shift of the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<Shift> <numeric value>

Range: 1 to 3
*RST: 2

Example: //Select a delta shift for the PUCCH
`CONF:UL:PUCC:DESH 3`

Manual operation: See " Delta Shift" on page 77

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:FORMat <Format>

Selects the PUCCH format.

Note that formats 2a and 2b are available for normal cyclic prefix length only.

Suffix:
<cc> Component Carrier

Parameters:
<Format>

F1 (F1)

F1A (F1a)

F1B (F1b)

F2 (F2)

F2A (F2a)

F2B (F2b)

F3 (F3)

SUBF
Allows you to define the PUCCH format for each subframe separately with .

*RST: F1

Example: //Select PUCCH format
`CONF:UL:PUCC:FORM F1B`

Manual operation: See " Format" on page 77

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:N1CS <Value>

Defines the N(1)_cs of the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value> (integer only)
*RST: 6

Example: //Select N(1)_cs
`CONF:UL:PUCC:N1CS 4`

Manual operation: See " N(1)_cs" on page 77

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:N2RB <Value>

Defines the N(2)_RB of the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value> (integer only)
*RST: 1

Example: //Define N2_RB
`CONF:UL:PUCC:N2RB 2`

Manual operation: See " N(2)_RB" on page 77

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:NORB <ResourceBlocks>

Selects the number of resource blocks for the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<ResourceBlocks> **<numeric value>**
Selects the number of RBs.
AUTO
Detects the number of RBs automatically.
*RST: 0

Example: //Define number of resource blocks for PUCCH
`CONF:UL:PUCC:NORB 6`

Manual operation: See " No. of RBs for PUCCH" on page 76

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:NPAR <Value>

Defines the N_PUCCH parameter in the PUCCH structure settings.

Suffix:
<cc> Component Carrier

Parameters:
<Value> <numeric value>

<numeric value>

AUTO
Determines the N_PUCCH based on the measurement.

SUBF
Selects the definition of N_PUCCH on subframe level.

*RST: 0

Example: //Select N_PUCCH
`CONF:UL:PUCC:NPAR 2`

Manual operation: See " N_PUCCH" on page 78

CONFigure[:LTE]:UL[:CC<cc>]:PUCCh:PLID <Identity>

Defines the (cell) identity of the PUCCH.

Suffix:
<cc> Component Carrier

Parameters:
<Identity> **FCID**
From cell ID: Uses the common Identity defined with `CONFigure[:LTE]:UL[:CC<cc>]:PLC:PLID` on page 183.

<numeric value>
Custom identity for the PUCCH (range: 1...2).

*RST: FCID

Example: //Select PUCCH identity
`CONF:UL:PUCC:PLID 0`

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 58

PRACH structure

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:APM <State>

Turns automatic preamble mapping for the PRACH on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0

Example: //Turn automatic preamble mapping on.
```
CONF:UL:PRAC:APM ON
```

Manual operation: See "PRACH Preamble Mapping" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:CONF <Configuration>

Selects the PRACH preamble format.

Suffix:
<cc> Component Carrier

Parameters:
<Configuration> <numeric value> (integer only)

Example: //Select PRACH configuration 2
```
CONF:UL:PRAC:CONF 2
```

Manual operation: See "PRACH Configuration" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:FOFFset <Offset>

Defines the PRACH frequency offset.

The command is available for preamble formats 0 to 3.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> <numeric value> (integer only)

Frequency offset in terms of resource blocks.

*RST: 0

Example: //Define a frequency offset
```
CONF:UL:PRAC:FOFF 5
```

Manual operation: See "Frequency Offset" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:FRINdex <FrequencyIndex>

Selects the PRACH frequency index.

Suffix:
<cc> Component Carrier

Parameters:

<FrequencyIndex> <numeric value> (integer only)

Example: //Select the frequency index
`CONF:UL:PRAC:FRIN 10`

Manual operation: See "PRACH Preamble Mapping" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:HFINdicator <Indicator>

Defines the PRACH half frame indicator.

Suffix:

<cc> Component Carrier

Parameters:

<Indicator> <numeric value>

Default unit: dB

Example: //Select half frame indicator
`CONF:UL:PRAC:HFIN 5`

Manual operation: See "PRACH Preamble Mapping" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:NCSC <Configuration>

Defines the Ncs configuration for the PRACH.

Suffix:

<cc> Component Carrier

Parameters:

<Configuration> <numeric value> (integer only)

Example: //Selects Ncs configuration
`CONF:UL:PRAC:NCSC 1`

Manual operation: See "Ncs Conf" on page 80

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:RSEQ <Index>

Defines the PRACH logical root sequence index.

Suffix:

<cc> Component Carrier

Parameters:

<Index> <numeric value> (integer only)

Example: //Select logical root sequence index
`CONF:UL:PRAC:RSEQ 2`

Manual operation: See "Logical Root Sequ. Idx" on page 80

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:RSET <State>

Turns the restricted preamble set for PRACH on and off.

Suffix:
<cc> Component Carrier

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on restricted set
`CONF:UL:PRAC:RSET ON`

Manual operation: See "Restricted Set" on page 79

CONFigure[:LTE]:UL[:CC<cc>]:PRACh:SINDex <Index>

Selects the PRACH sequence index.

Suffix:
<cc> Component Carrier

Parameters:
<Index> **<IndexValue>**
Number that defines the index manually.
AUTO
Automatically determines the index.

Example: //Select sequence index
`CONF:UL:PRAC:SIND 2`

Manual operation: See "Sequence Index (v)" on page 80

7.10.2.2 Input configuration

Remote commands to configure the input described elsewhere:

- `INPut:COUPling` on page 215
- `INPut:IMPedance` on page 216

INPut:FILE:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

The I/Q data file must be in one of the following supported formats:

- `.iq.tar`
- `.iqw`
- `.csv`
- `.mat`
- `.wv`
- `.aid`

Only a single data stream or channel can be used as input, even if multiple streams or channels are stored in the file.

For some file formats that do not provide the sample rate and measurement time or record length, you must define these parameters manually. Otherwise the traces are not visible in the result displays.

Parameters:

<FileName> String containing the path and name of the source file.
The file type is determined by the file extension. If no file extension is provided, the file type is assumed to be `.iq.tar`.
For `.mat` files, Matlab® v4 is assumed.

<AnalysisBW> Optionally: The analysis bandwidth to be used by the measurement. The bandwidth must be smaller than or equal to the bandwidth of the data that was stored in the file.
Default unit: HZ

Example: `INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'`
Uses I/Q data from the specified file as input.

Example:

```
//Load an IQW file
INP:SEL:FIQ
INP:FILE:PATH 'C:\R_S\Instr\user\data.iqw'
//Define the sample rate
TRAC:IQ:SRAT 10MHz
//Define the measurement time
SENSe:SWEep:TIME  0.001001
//Start the measurement
INIT:IMM
```

Manual operation: See "Select I/Q data file" on page 82
See "Data import and export" on page 100

INPut:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Parameters:

<State> ON | OFF | 0 | 1

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 81

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSV/A.

If no additional input options are installed, only RF input or file input is supported.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

FIQ
I/Q data file
(selected by `INPut:FILE:PATH` on page 208)

*RST: RF

Manual operation: See "I/Q Input File State" on page 81

MMEMory:LOAD:IQ:STReam <Channel>

Only available for files that contain more than one data stream from multiple channels: selects the data stream to be used as input for the currently selected channel.

Automatic mode (`MMEMory:LOAD:IQ:STReam:AUTO`) is set to OFF.

Parameters:

<Channel> String containing the channel name.

Example:

```
MMEM:LOAD:IQ:STR?
//Result: 'Channel1','Channel2'
MMEM:LOAD:IQ:STR 'Channel2'
```

Manual operation: See "Selected Channel" on page 82

MMEMory:LOAD:IQ:STReam:AUTO <State>

Only available for files that contain more than one data stream from multiple channels: automatically defines which data stream in the file is used as input for the channel.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The data stream specified by `MMEMory:LOAD:IQ:STReam` is used as input for the channel.

ON | 1
The first data stream in the file is used as input for the channel. Applications that support multiple data streams use the first data stream in the file for the first input stream, the second for the second stream etc.

*RST: 1

Manual operation: See "Selected Channel" on page 82

MMEMory:LOAD:IQ:STReam:LIST?

Returns the available channels in the currently loaded input file.

Example: `MMEM:LOAD:IQ:STR?`
`//Result: 'Channel1','Channel2'`

Usage: Query only

Manual operation: See "Selected Channel" on page 82

TRACe:IQ:FILE:REPetition:COUNt <RepetitionCount>

Determines how often the data stream is repeatedly copied in the I/Q data memory. If the available memory is not sufficient for the specified number of repetitions, the largest possible number of complete data streams is used.

Parameters:
<RepetitionCount> integer

Example: `TRAC:IQ:FILE:REP:COUN 3`

Manual operation: See "File Repetitions" on page 82

7.10.2.3 Frequency configuration

[SENSe:]FREQuency:CENTer[:CC<cc>] <Frequency>

Sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with `FREQ:CENT:CC1`. The `CC1` part of the syntax is mandatory in that case.
- `FREQ:CENT?` queries the measurement frequency (center of the two carriers).

Suffix:
<cc> Component Carrier

Parameters:
<Frequency> <numeric value>

Range: fmin to fmax
*RST: 1 GHz
Default unit: Hz

Example: //Define frequency for measurement on one carrier:
`FREQ:CENT 1GHZ`

Example: //Define frequency for measurement on aggregated carriers:
`FREQ:CENT:CC1 850MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56
See "Center Frequency" on page 83

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

Defines the general frequency offset.

For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the `[CC<cc>]` syntax element, the command defines the overall frequency offset.
  In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.
- When you include the `[CC<cc>]` syntax element, the command defines the offset of the component carrier relative the first component carrier.
  In that case, the command is not available for the first component carrier - thus, `...:CC1:...` is not possible.

Suffix:
<cc> Component Carrier

Parameters:
<Offset> <numeric value>

• General frequency offset: frequency offset in Hz.
• Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
//If you are measuring component carriers, the value is also added to the center frequencies of those carriers.
`FREQ:CENT:OFFS 50HZ`

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.
`FREQ:CENT:CC2:OFFS 15MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56
See "Center Frequency" on page 83

[SENSe:]FREQuency:CENTer:STEP <StepSize>

Defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` and `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 211.

Parameters:

<StepSize> For f_{max}, refer to the specifications document.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example: //Set the center frequency to 110 MHz.

```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```

Manual operation: See "Frequency Stepsize" on page 83

7.10.2.4 Amplitude configuration

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel <ReferenceLevel>

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<ReferenceLevel> The unit is variable.

Range: see specifications document
*RST: 0 dBm
Default unit: DBM

Example: `DISP:TRAC:Y:RLEV -60dBm`

Manual operation: See "Reference Level" on page 84

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel:OFFSet <Offset>

Defines a reference level offset (for all traces in all windows).

Suffix:

<n> irrelevant

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<Offset> Range: -200 dB to 200 dB
*RST: 0dB
Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "Reference Level Offset" on page 85

INPut:ATTenuation<ant> <Attenuation>

Defines the RF attenuation level.

Prerequisites for this command

- Decouple attenuation from reference level (`INPut:ATTenuation<ant>:AUTO`).

Suffix:

<ant> irrelevant

Parameters:

<Attenuation> *RST: 10 dB
Default unit: dB

Example: //Define RF attenuation
```
INP:ATT:AUTO OFF
INP:ATT 10
```

Manual operation: See "RF Attenuation" on page 85

INPut:ATTenuation<ant>:AUTO <State>

Couples and decouples the RF attenuation to the reference level.

Suffix:

<ant> irrelevant

Parameters:

<State> ON | OFF | 1 | 0
*RST: ON

Example: //Couple attenuation to reference level (auto attenuation)
```
INP:ATT:AUTO ON
```

Manual operation: See "RF Attenuation" on page 85

INPut:COUPling <CouplingType>

Selects the coupling type of the RF input.

If an external frontend is active, the coupling is automatically set to `AC`.

Parameters:

<CouplingType> AC | DC

AC
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 87

INPut:GAIN:STATe <State>

Turns the internal preamplifier on and off. It requires the optional preamplifier hardware.

For R&S FSV/A44 models, note the restrictions described in "Preamplifier" on page 86.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 15
```
Switches on 15 dB preamplification.

Manual operation: See "Preamplifier" on page 86

INPut:GAIN[:VALue] <Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 215).

The command requires the additional preamplifier hardware option.

For R&S FSV/A44 or higher models, note the restrictions described in "Preamplifier" on page 86.

Parameters:

<Gain> The following settings are available:
15 dB and 30 dB
All other values are rounded to the nearest of these two.
Default unit: DB

Example:
```
INP:GAIN:STAT ON
INP:GAIN:VAL 30
```
Switches on 30 dB preamplification.

Manual operation: See "Preamplifier" on page 86

INPut:IMPedance <Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Parameters:

<Impedance> 50 | 75
*RST: 50 Ω
Default unit: OHM

Example:
```
INP:IMP 75
```

Manual operation: See "Impedance" on page 87

INPut:EATT<ant> <Attenuation>

Defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Suffix:

<ant> Connected instrument

Parameters:

<Attenuation> Attenuation level in dB.
Default unit: dB

Example: //Define signal attenuation
```
INP:EATT 10
```

Manual operation: See "Electronic Attenuation" on page 86

INPut:EATT<ant>:AUTO <State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Suffix:

<ant> 1...4
Connected instrument

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on automatic selection of electronic attenuation
`INP:EATT:AUTO ON`

Manual operation: See "Electronic Attenuation" on page 86

INPut:EATT<ant>:STATe <State>

Turns the electronic attenuator on and off.

Suffix:
<ant> 1...4
Connected instrument

Parameters:
<State> ON | OFF
*RST: OFF

Example: //Turn on electronic attenuation
`INP:EATT:STAT ON`

Manual operation: See "Electronic Attenuation" on page 86

7.10.2.5 Data capture

[SENSe:][LTE:]FRAMe:COUNt <Subframes>

Defines the number of frames you want to analyze.

Prerequisites for this command

- Turn on overall frame count (`[SENSe:][LTE:]FRAMe:COUNt:STATe`).
- Turn on manual selection of frames to analyze (`[SENSe:][LTE:]FRAMe:COUNt:AUTO`).

Parameters:
<Subframes> <numeric value> (integer only)
*RST: 1

Example: //Define number of frames to analyze manually
```
FRAM:COUN:STAT ON
FRAM:COUN:AUTO OFF
FRAM:COUN 20
```

Manual operation: See "Number of Frames to Analyze" on page 89

[SENSe:][LTE:]FRAMe:COUNt:AUTO <State>

Turns automatic selection of the number of frames to analyze on and off.

Parameters:
<State>

ON | 1
Selects the analyzed number of frames according to the LTE standard.

OFF | 0
Turns on manual selection of the number of frames.

Example: //Turn on automatic selection of analyzed frames
`FRAM:COUN:AUTO ON`

Manual operation: See "Auto According to Standard" on page 89

[SENSe:][LTE:]FRAMe:COUNt:STATe <State>

Turns manual selection of the number of frames you want to analyze on and off.

Parameters:
<State>

ON | 1
You can set the number of frames to analyze.

OFF | 0
The R&S FSV/A analyzes the frames captured in a single sweep.

*RST: ON

Example: //Turn on manual selection of number of frames
`FRAM:COUN:STAT ON`

Manual operation: See "Overall Frame Count" on page 88

[SENSe:][LTE:]FRAMe:SSUBframe <State>

Turns the analysis of a single subframe only on and off.

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Evaluate a single subframe only
`FRAM:SSUB ON`

Manual operation: See "Single Subframe Mode" on page 89

[SENSe:]SWAPiq <State>

Turns a swap of the I and Q branches on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Swap I and Q branches

```
SWAP ON
```

Manual operation: See "Swap I/Q" on page 88

[SENSe:]SWEep:TIME <CaptureLength>

Defines the capture time.

Parameters:

<CaptureLength> <numeric value>

*RST: 20.1 ms / 40.1 ms (DL TDD)

Default unit: s

Example: //Define capture time

```
SWE:TIME 40ms
```

Manual operation: See "Capture Time" on page 88

7.10.2.6 Trigger

The trigger functionality of the LTE measurement application is the same as that of the R&S FSV/A.

For a comprehensive description of the available remote control commands for trigger configuration, see the documentation of the R&S FSV/A.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:

<DropoutTime> Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

Defines the trigger offset.

Suffix:

<ant> Instrument

Parameters:

<Offset> <numeric value>

*RST: 0 s
Default unit: s

Example: //Define trigger offset
`TRIG:HOLD 5MS`

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:

<Period> Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example: `TRIG:SOUR EXT`
Sets an external trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB
Default unit: DB

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HYST 10DB`
Sets the hysteresis limit value.

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>] <Level>

Defines the level for an external trigger.

Suffix:
<ant> Instrument

<tp> Trigger port

Parameters:
<Level> Range: 0.5 V to 3.5 V
*RST: 1.4 V
Default unit: V

Example: //Define trigger level
`TRIG:LEV 2V`

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:LEVel<ant>:IFPower <Level>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:
<ant> Instrument

Parameters:
<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the specifications document.

*RST: -10 dBm
Default unit: dBm

Example: //Define trigger level
`TRIG:SOUR IFP`
`TRIG:LEV:IFP -30dBm`

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:
<ant> Instrument

Parameters:
<Level> <numeric value>

Range: -130 dBm to 30 dBm
*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
```
TRIG:SOUR IQP
TRIG:LEV:IQP -30dBm
```

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

Defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:
<ant> Instrument

Parameters:
<Level> <numeric value>

For details on available trigger levels and trigger bandwidths see the specifications document.

*RST: -20 dBm
Default unit: dBm

Example: //Define trigger level
```
TRIG:SOUR RFP
TRIG:LEV:RFP -30dBm
```

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:PORT<ant> <port>

Selects the trigger port for measurements with devices that have several trigger ports.

Suffix:
<ant> Analyzer

Parameters:
<port>

PORT1

PORT2

PORT3

Example: //Select trigger port 1
`TRIG:PORT PORT1`

TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: `TRIG:SLOP NEG`

Manual operation: See "Trigger Source" on page 90

TRIGger[:SEQuence]:SOURce<ant> <Source>

Selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:

<ant> Analyzer

Parameters:

<Source>

IMMediate
Free run (no trigger event to start a measurement).

EXTernal
Measurement starts when the external trigger signal exceeds a certain level.
Trigger signal from the "Trigger Input/Output" connector.
Note: Connector must be configured for "Input".

EXT2
Trigger signal from the "Trigger Input / Output" connector.
Note: Connector must be configured for "Input".

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)

IFPower
Measurement starts when the second intermediate frequency exceeds a certain level.

IQPower
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

PSEN
External power sensor

*RST: IMMediate

Manual operation: See "Trigger Source" on page 90

7.10.2.7 Demodulation

[SENSe:][LTE:]UL:DEMod:ATTSlots <State>

Includes or excludes the transient slots present after a switch from downlink to uplink from the analysis.

Parameters:

<State> ON | OFF | 1 | 0

Example: //Analyze transient slots
`UL:DEM:ATTS ON`

Manual operation: See "Analyze TDD Transient Slots" on page 93

[SENSe:][LTE:]UL:DEMod:MODE <Mode>

Selects the uplink analysis mode.

Parameters:

<Mode>

PUSCh
Analyzes the PUSCH and PUCCH.

PRACh
Analyzes the PRACH.

*RST: PUSCh

Example: //Select PRACH analysis mode
`UL:DEM:MODE PRAC`

Manual operation: See "Analysis Mode" on page 92

[SENSe:][LTE:]UL:DEMod:CESTimation <Type>

Selects the channel estimation type.

Parameters:
<Type> **PIL**
Pilot only
PILP
Pilot and payload
*RST: PILP

Example: //Use the pilot signal for channel estimation
`UL:DEM:CEST PIL`

Manual operation: See "Channel Estimation Range" on page 93

[SENSe:][LTE:]UL:DEMod:EEPeriod <State>

Includes or excludes the exclusion period from EVM results.

Parameters:
<State> ON | OFF | 1 | 0

Example: //Turn on exclusion periods for EVM calculation
`UL:DEM:EEP ON`

Manual operation: See "EVM with Exclusion Period" on page 93

[SENSe:][LTE:]UL:DEMod:CDCoffset <State>

Turns DC offset compensation on and off.

Parameters:
<State> ON | OFF | 1 | 0
*RST: ON

Example: //Turn off DC offset compensation
`UL:DEM:CDC OFF`

Manual operation: See "Compensate DC Offset" on page 93

[SENSe:][LTE:]UL:DEMod:CBSCrambling <State>

Turns scrambling of coded bits on and off.

Parameters:
<State> ON | OFF | 1 | 0
*RST: ON

Example: //Turn off descrambling of coded bits
`UL:DEM:CBSC OFF`

Manual operation: See "Scrambling of Coded Bits" on page 93

[SENSe:][LTE:]UL:DEMod:SISYnc <State>

Turns suppressed interference synchronization on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on suppressed interference synchronization

```
UL:DEM:SISY ON
```

Manual operation: See "Suppressed Interference Synchronization" on page 94

[SENSe:][LTE:]UL:DEMod:MCFilter <State>

Turns suppression of interfering neighboring carriers on and off (for example LTE, WCDMA, GSM etc.).

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on interference suppression

```
UL:DEM:MCF ON
```

Manual operation: See "Multicarrier Filter" on page 94

7.10.2.8 Tracking

[SENSe:][LTE:]UL:TRACking:PHASe <Type>

Selects the phase tracking method.

Parameters:

<Type>

OFF
Deactivate phase tracking

PIL
Pilot only

PILP
Pilot and payload

*RST: OFF

Example: //Use pilots and payload for channel estimation

```
SENS:UL:TRAC:PHAS PILP
```

Manual operation: See "Phase" on page 91

[SENSe:][LTE:]UL:TRACking:TIME <State>

Turns timing tracking on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on time tracking
`UL:TRAC:TIME ON`

Manual operation: See "Time Tracking" on page 92

7.10.2.9 Automatic configuration

Commands to configure the application automatically described elsewhere.

- `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO`

[SENSe:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the R&S FSV/A performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Auto Level" on page 84

[SENSe:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the R&S FSV/A performs a measurement on the current input data. This command selects the way the R&S FSV/A determines the length of the measurement .

Parameters:

<Mode> **AUTO**
The R&S FSV/A determines the measurement length automatically according to the current input data.

MANual
The R&S FSV/A uses the measurement length defined by
[SENSe:]ADJust:CONFigure:LEVel:DURation
on page 227.

*RST: AUTO

Manual operation: See "Auto Level" on page 84

[SENSe:]ADJust:CONFigure:LTE

Automatically detects several signal characteristics and selects the appropriate parameters in the application.

The following signal characteristics are automatically detected.

- Carrier bandwidth

Example: //Determine signal characteristics based on the measurement signal
`ADJ:CONF:LTE`

Usage: Event

[SENSe:]ADJust:LEVel<ant>

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSV/A or limiting the dynamic range by an S/N ratio that is too small.

Suffix:
<ant> 1...4
Connected instrument

Example: //Auto level on one instrument
`ADJ:LEV2`

Usage: Event

Manual operation: See "Auto Level" on page 84
See "Auto leveling" on page 94

7.10.3 Time alignment error measurements

All commands specific to the time alignment error measurement are listed below.

Commands to configure the time alignment error measurement described elsewhere:

- [SENSe:]FREQuency:CENTer[:CC<cc>] on page 211
- Commands in "Subframe configuration" on page 188
- Commands in "Demodulation reference signal" on page 194

- Commands in "PUSCH structure" on page 201

CONFigure[:LTE]:CAGGregation:STATe <State>

Turns carrier aggregation for time alignment error measurements on and off.

You can select the number of component carriers with `CONFigure[:LTE]:NOCC`.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Select 2 component carrier

```
CONF:CAGG:STAT ON
CONF:NOCC 2
```

CONFigure[:LTE]:NOCC <Carrier>

Selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier> Number of the component carriers that you would like to measure. The range depends on the measurement.
For more information see "Carrier Aggregation" on page 53.

*RST: 1

Example: //Select number of component carriers

```
CONF:NOCC 2
```

Manual operation: See "Remote commands to configure carrier aggregation" on page 56

7.10.4 Frequency sweep measurements

Please refer to the documentation of the R&S FSV/A base unit for a comprehensive list and description of remote commands necessary to configure and perform frequency sweep measurements (ACLR and SEM).

All commands specific to the LTE application are listed below.

Commands to configure frequency sweep measurements described elsewhere:

- `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 212

CONFigure[:LTE]:UL:CABW <Bandwidth>

Selects the channel bandwidth(s) of the carriers in MC ACLR measurements.

Parameters:

<Bandwidth>

B510
First carrier: 5 MHz, second carrier: 10 MHz bandwidth.

B520
First carrier: 5 MHz, second carrier: 20 MHz bandwidth.

B1010
First carrier: 10 MHz, second carrier: 10 MHz bandwidth.

B1015
First carrier: 10 MHz, second carrier: 15 MHz bandwidth.

B1020
First carrier: 10 MHz, second carrier: 20 MHz bandwidth.

B1515
First carrier: 15 MHz, second carrier: 15 MHz bandwidth.

B1520
First carrier: 15 MHz, second carrier: 20 MHz bandwidth.

B2020
First carrier: 20 MHz, second carrier: 20 MHz bandwidth.

USER
Custom combination of bandwidths. Define the bandwidths of both carriers with `CONFigure[:LTE]:UL[:CC<cc>]:BW` on page 181.

Example:
//Custom bandwidth combination: first carrier 5 MHz, second carrier 5 MHz

```
CONF:UL:CABW USER
CONF:UL:CC1:BW BW5_00
CONF:UL:CC2:BW BW5_00
```

Manual operation: See "Remote commands to configure carrier aggregation" on page 56

CONFigure[:LTE]:NDEVices <Devices>

Selects the number of R&S FSV/A used in a time alignment error measurement with carrier aggregation.

(Note that for uplink time alignment error measurements, the number of devices is always '1'.)

Parameters:

<Devices>

1
Performs a broadband measurement over all component carriers on a single R&S FSV/A.

2
Performs a measurement on two R&S FSV/A, each one analyzing a single component carrier.

*RST: 1

Example: //Select broadband measurement over all CCs
`CONF:NDEV 1`

Manual operation: See "Remote commands to configure carrier aggregation" on page 56

[SENSe:]POWer:ACHannel:AACHannel <Channel>

Selects the bandwidth of the adjacent channel for ACLR measurements.

Parameters:

<Channel>

EUTRA
Selects an EUTRA signal of the same bandwidth like the TX channel as assumed adjacent channel carrier.

UTRA128
Selects an UTRA signal with a bandwidth of 1.28MHz as assumed adjacent channel carrier.

UTRA384
Selects an UTRA signal with a bandwidth of 3.84MHz as assumed adjacent channel carrier.

UTRA768
Selects an UTRA signal with a bandwidth of 7.68MHz as assumed adjacent channel carrier.

*RST: EUTRA

Example: //Select assumed adjacent channel
`POW:ACH:AACH UTRA384`

Manual operation: See "Assumed Adjacent Channel Carrier" on page 96

[SENSe:]POWer:SEM:UL:REQuirement <Requirement>

Selects the requirements for a spectrum emission mask.

Parameters:

<Requirement>

GEN
General spectrum emission mask.

NS3 | NS4 | NS67 | NS27 | NS35
Spectrum emission masks with additional requirements.

Example: //Select a spectrum emission mask
`POW:SEM:UL:REQ NS3`

Manual operation: See "SEM Requirement" on page 97

CALCulate<n>:LIMit<li>:ACPower:PMODe <Mode>

Selects the limit evaluation mode for ACLR measurements.

Supported for ACLR measurements in the LTE and 5G applications.

Suffix:

<n>	irrelevant
	irrelevant

Parameters:

<Mode>

AND
Overall limit check passes if both absolute and relative limit checks pass.

OR
Overall limit check passes if either absolute or relative limit checks pass.

*RST: AND

Example:
//Select evaluation mode
`CALC:LIM:ACP:PMOD AND`

7.11 Analysis

7.11.1 Trace export

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example:
`FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see MMEMory:STORe<n>:TRACe on page 233).

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the MMEMory:STORe<n>:TRACe command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the MMEMory:STORe<n>:TRACe command is ignored.

*RST: SINGle

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

Secure User Mode

In secure user mode, settings that are stored on the instrument are stored to volatile memory, which is restricted to 256 MB. Thus, a "memory limit reached" error can occur although the hard disk indicates that storage space is still available.

To store data permanently, select an external storage location such as a USB memory device.

For details, see "Protecting Data Using the Secure User Mode" in the "Data Management" section of the R&S FSV3000/ FSVA3000 base unit user manual.

Suffix:

<n> Window

Parameters:

<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

7.11.2 Microservice export

MMEMory:STORe<n>:MSERvice <FileName>

Exports the signal configuration to the microservice.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the file.
The file extension is `.m5g`.

Example: //Export to microservice
`MMEM:STOR:MSER 'signal.xxx'`

7.11.3 Evaluation range

[SENSe:][LTE:][CC<cc>:]ALLocation:SELect <Allocation>

Filters the displayed results in the constellation diagram by a certain type of allocation.

Suffix:
<cc> Component Carrier

Parameters:
<Allocation> **ALL**
Shows the results for all allocations.

<numeric_value> (integer only)
Shows the results for a single allocation type.
Allocation types are mapped to numeric values. For the code assignment, see Chapter 7.7.1.20, "Return value codes", on page 142.

*RST: ALL

Example: //Display results for PUSCH
`ALL:SEL -40`

Manual operation: See "Evaluation range for the constellation diagram" on page 106

[SENSe:][LTE:][CC<cc>:]CARRier:SELect <Carrier>

Filters the results in the constellation diagram by a certain subcarrier.

Suffix:
<cc> Component Carrier

Parameters:
<Carrier>

ALL
Shows the results for all subcarriers.

<numeric_value> (integer only)
Shows the results for a single subcarrier.

*RST: ALL

Example: //Display results for subcarrier 1
`CARR:SEL 1`

Manual operation: See "Evaluation range for the constellation diagram" on page 106

[SENSe:][LTE:][CC<cc>:]MODulation:SELect <Modulation>

Filters the results in the constellation diagram by a certain type of modulation.

Suffix:
<cc> Component Carrier

Parameters:
<Modulation>

ALL
Shows the results for all modulation types.

<numeric_value> (integer only)
Shows the results for a single modulation type.
Modulation types are mapped to numeric values. For the code assignment, see Chapter 7.7.1.20, "Return value codes", on page 142.

*RST: ALL

Example: //Display results for all elements with a QPSK modulation
`MOD:SEL 2`

Manual operation: See "Evaluation range for the constellation diagram" on page 106

[SENSe:][LTE:][CC<cc>:]PREamble:SELect <Subframe>

Selects a certain preamble for measurements that analyze individual preambles.

Prerequisites for this command

- Select PRACH analysis mode (`[SENSe:][LTE:]UL:DEMod:MODE` on page 224).

Suffix:
<cc> Component Carrier

Parameters:
<Preamble>

ALL
Analyzes all preambles.

<numeric value> (integer only)
Analyzes a single preamble.

*RST: ALL

Example: //Analyze all preambles
`PRE:SEL ALL`

Manual operation: See "Preamble Selection" on page 105

[SENSe:][LTE:][CC<cc>:]SLOT:SELect <Slot>

Filters the results in the constellation diagram by a particular slot.

Suffix:
<cc> Component Carrier

Parameters:
<Slot>

S0
Slot 0

S1
Slot 1

ALL
Both slots

*RST: ALL

Example: //Display results for all slots
`SLOT:SEL ALL`

Manual operation: See "Slot Selection" on page 105

[SENSe:][LTE:][CC<cc>:]SUBFrame:SELect <Subframe>

Selects the subframe to be analyzed.

Suffix:
<cc> Component Carrier

Parameters:
<Subframe> ALL | <numeric value>

ALL
Select all subframes

0...39
Select a single subframe

*RST: ALL

Example: //Display results for all subframes
`SUBF:SEL ALL`

Manual operation: See "Subframe Selection" on page 104

[SENSe:][LTE:][CC<cc>:]SYMBol:SELect <Symbol>

Filters the results in the constellation diagram by a certain OFDM symbol.

Suffix:
<cc> Component Carrier

Parameters:
<Symbol>

ALL
Shows the results for all subcarriers.

<numeric_value> (integer only)
Shows the results for a single OFDM symbol.

*RST: ALL

Example: //Display result for OFDM symbol 2
`SYMB:SEL 2`

Manual operation: See "Evaluation range for the constellation diagram" on page 106

7.11.4 Y-axis scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

Automatically scales the y-axis of a diagram based on the displayed results.

Suffix:
<n> Window

<w> Subwindow

<t> irrelevant

Setting parameters:
<ONCE>

ALL
Scales the y-axis in all windows for an ideal viewing experience.

DEFault
Restores the default scale of the y-axis.

ONCE
Scales the y-axis in a specific window for an ideal viewing experience.

Example: //Automatically scale the y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`

Usage: Setting only

Manual operation: See "Auto Scaling" on page 95
See "Automatic scaling of the y-axis" on page 101

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum <Value>

Defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Parameters:

<Value> Maximum displayed value. The unit and value range depend on the selected diagram.

Example: //Define maximum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MAX 0`

Manual operation: See "Manual scaling of the y-axis" on page 101

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum <Value>

Defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Parameters:

<Value> Minimum displayed value. The unit and value range depend on the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
`DISP:WIND2:SUBW2:TRAC:Y:MIN -50`

Manual operation: See "Manual scaling of the y-axis" on page 101

7.11.5 Result settings

CALCulate<n>:MARKer<m>:COUPling <State>

Couples or decouples markers in different result displays to each other.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Couple markers to each other.
```
CALC:MARK:COUP ON
```

Manual operation: See "Marker Coupling" on page 107

DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

Couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like carrier aggregation).

Suffix:

<n> Window

<w> Subwindow

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on subwindow coupling
```
DISP:COUP ON
```

Manual operation: See "Subwindow Coupling" on page 107

UNIT:BSTR <Unit>

Selects the way the bit stream is displayed.

Parameters:

<Unit> **SYMbols**
Displays the bit stream using symbols

BITs
Displays the bit stream using bits
*RST: SYMbols

Example: //Display bit stream as bits
`UNIT:BSTR BIT`

Manual operation: See "Bit Stream Format" on page 107

UNIT:CAXes <Unit>

Selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:
<Unit>

CARR
Shows the number of the subcarriers on the x-axis.

HZ
Shows the frequency of the subcarriers on the x-axis.

Example: //Display frequency on the x-axis
`UNIT:CAX HZ`

Manual operation: See "Carrier Axes" on page 107

UNIT:EVM <Unit>

Selects the EVM unit.

Parameters:
<Unit>

DB
EVM results returned in dB

PCT
EVM results returned in %
*RST: PCT

Example: //Display EVM results in %
`UNIT:EVM PCT`

Manual operation: See "EVM Unit" on page 106

7.12 Reading out status register

The following commands are required to read out the `STATus:QUEStionable:SYNC` status register.

For a full list of commands required to read out the status register, refer to the R&S FSV/A user manual.

STATus:QUEStionable:SYNC[:EVENt]? <ChannelName>

Reads out the EVENt section of the status register.

The command also deletes the contents of the EVENt section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATus:QUEStionable:SYNC:CONDition? <ChannelName>

Reads out the CONDition section of the status register.

The command does not delete the contents of the EVENt section.

Query parameters:

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

STATus:QUEStionable:SYNC:ENABle <BitDefinition>, <ChannelName>

Controls the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:NTRansition <BitDefinition>[,<ChannelName>]

Controls the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

STATus:QUEStionable:SYNC:PTRansition <BitDefinition>[,<ChannelName>]

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Parameters:

<BitDefinition> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

List of remote commands (LTE uplink)

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